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American National Standard for Information Systems — Microprocessors — Hexadecimal Input/Output, Using 5-Bit and 7-Bit Teleprinters

Secretariat

Computer and Business Equipment Manufacturers Association

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American National Standard

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Foreword

(This Foreword is not a part of American National Standard X3.95-1982.)

This American National Standard presents the standard transformations to be accomplished in order to interface any 8-bit pattern to or from a microcomputer and traditional equipment, such as communications teleprinters, that generates only 5 bits or 7 bits to represent coded character information.

The specification of such transformation is of particular importance to the computer hobbyist. It will expedite the use of low-cost (surplus) teleprinter equipment to serve as the control console of low-cost microcomputers, and will also permit the quantity fabrication of low-cost integrated circuit chips to perform the transformation specified by this standard. Others using new equipment conforming to the American National Standard Code for Information Interchange (ASCII), ANSI X3.4-1977, should also benefit from reduced costs.

The transformation specifications were developed after a careful review of microcomputer requirements and studies of the availability of equipment suitable for use as the control console of microcomputers.

Suggestions for improvement of this standard will be welcome. They should be sent to the Computer and Business Equipment Manufacturers Association, 1828 L Street, N.W., Washington, D.C. 20036.

This standard was processed and approved for submittal to ANSI by American National Standards Committee on Information Processing Systems, X3. Committee approval of the standard does not necessarily imply that all committee members voted for its approval. At the time it approved this standard, the X3 Committee had the following members:

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American National Standard for Information Systems – Microprocessors – Hexadecimal Input/Output, Using 5-Bit and 7-Bit Teleprinters

1. Scope

This standard specifies the relationship between commonly available 5-bit (Baudot) and 7-bit (ASCII) teleprinter character codes and 8-bit patterns used at the interface to microcomputers.

Illustrative figures to aid in understanding this standard, along with historical background statements, appear in the appendixes.

2. Purpose

The purpose of this standard is to provide uniformity in the translation of the character coding employed in the most prevalent surplus teleprinters to and from the bit patterns employed to interface most microcomputers, to expedite the interchange of software among computer users such as computer hobbyists and others.

3. Referenced American National Standards

The following referenced standards are available from the American National Standards Institute, 1430 Broadway, New York, N.Y. 10018:

ANSI X3.4-1977, American National Standard Code for Information Interchange. (Similar to 7-Bit Coded Character Set for Information Processing Interchange, ISO 646-1973, also available from ANSI.)

ANSI X3.6-1965, American National Standard Perforated Tape Code for Information Interchange.

ANSI X3.14-1973, American National Standard Recorded Magnetic Tape for Information Interchange (200 CPI, NRZI).

ANSI X3.15-1976, American National Standard for Bit Sequencing of the American National Standard Code for Information Interchange in Serial-by-Bit Data Transmission.

ANSI X3.16-1976, American National Standard Character Structure and Character Parity Sense for Serial-by-Bit Data Communication in the American National Standard Code for Information Interchange.

ANSI X3.18-1974, American National Standard One-Inch Perforated Paper Tape for Information Interchange.

ANSI X3.19-1974, American National Standard Eleven-Sixteenths-Inch Perforated Paper Tape for Information Interchange.

ANSI X3.41-1974, American National Standard Code Extension Techniques for Use with the 7-Bit Coded Character Set of American National Standard Code for Information Interchange. (Similar to Code Extension Techniques for Use with the ISO 7-Bit Coded Character Set, ISO 2022-1973.)

ANSI X4.23-1982, American National Standard for Office Machines and Supplies – Alphanumeric Machines – Keyboard Arrangement.

4. General

4.1 Microcomputer Interface Character Code. Most microcomputers built in the United States employ an 8-bit representation for the input and output of character-coded information. There are thus 256 bit patterns that can represent characters of either control or graphic types. The 7 low order bits generally represent the ASCII characters of ANSI X3.4-1977, and the 7 bits serve as the 7 low order bits of the 8-bit characters, in accordance with ISO 2022-1973 or ANSI X3.41-1974 on code extension techniques. For all 128 ASCII characters, the eighth (high order) bit is set to a value of "zero." It has a value of "one" for the other 128 non-ASCII character positions.

4.2 Representation of Full Microcomputer Interface Code. The 8-bit representation of microcomputer interface code provides 256 unique bit patterns. Five-bit teleprinters generally operate with 32 unique bit patterns representing only 58 characters. Seven-bit teleprinters are often monocase (uppercase only in the United States; often lowercase only in Europe) with 64 graphic bit patterns and up to 32 control function bit patterns. They may conform to the older ASCII found in an earlier edition of ANSI X3.4-1977. In either 5-bit or 7-bit teleprinters, many of the 256 unique bit patterns of microcomputers cannot be generated or accepted with meaning. One purpose of this standard is to provide a means to "Escape" from normal character mode into a 4-bit hexadecimal mode. This operation can be accomplished by specifying a uniform means of generating the 16 unique bit patterns of 4-bit coding and a means of combining two 4-bit patterns into an 8-bit pattern. Accordingly, all 256 unique bit patterns needed to interface to microcomputers can be generated or received by either 5-bit or 7-bit teleprinters.

NOTE: The method of starting execution or of conditioning the microprocessor to accept hexadecimal input shall be implementor-defined and is not specified in this standard.

4.3 Availability and Costs of Hardware. Microcomputers are readily available to hobbyists and others, either prefabricated or in kit form. However, a control console and input-output equipment may prove to be prohibitively costly for the hobbyist. One economic solution is to use a surplus teleprinter with paper tape reader and punch to serve the dual functions of control console and automated input-output device at an additional cost comparable with the initial cost of the microcomputer, rather than several times the cost of the microcomputer if suitable new equipment were to be purchased.

5. Five-Bit Teleprinter Codes

5.1 Three-Row Keyboards. Most 5-bit teleprinters employ a 3-row keyboard similar to the ones shown in Fig. A1, taken from Military Communication System Technical Standards, U.S. Military Standard MIL-STD-188C, 24 November 1969. The alphabetic letters are arranged in the familiar "QWERTY" sequence in accordance with most American typewriters and ANSI X4.23-1982. Unlike that standard, however, the 10-decimal digits are located on the same keytops as some of the letters. The keys marked "FIGS" and "LTRS" (Figures and Letters) serve as precedence keys to differentiate the interpretation of the two characters on most keytops just as "Shift" does on a typewriter. "FIGS" and "LTRS" serve as locking shifts. Except for the precedence state (FIGS or LTRS), the same bit pattern serves to represent the two characters. Thus, "E" and "3" have the same 5-bit pattern as shown in the code table of Fig. A2, which is also taken from MIL-STD-188C. On American-built teleprinters, there are no lowercase letters, although Fig. A2 shows "lowercase." The lower position on each key represents capital letters in the United States.

5.2 Code Chart. Five-bit teleprinters normally emit a serial bit stream beginning with a "Start" bit and ending with a "Stop" bit, as shown in Fig. A2. Fig. A2 also shows the International Consultative Committee on Telegraph and Telephone (CCITT) International Telegraph Alphabet (ITA) No. 2 international differences from American practice. Bits 1 through 5 are the information bits, and these may be read out or read into the teleprinter in parallel form instead of serially by bit. Surplus 5-bit teleprinters may be of either the American or international varieties. The differences, as previously mentioned, are shown in Fig. A2. For example, "Bell" may be associated with the Figure shift of either "S" (American) or "J" (international).

5.3 Paper Tape. A 5-level, 17.5 mm- (11/16 inch-) wide paper tape is generally used with 5-bit teleprinters, and the information is transferred to and from the tape reader/punch in 5-bit parallel form. The paper tapes conform to ANSI X3.19-1974 in physical dimensions. In American-built 5-level paper tape equipment, the feed holes (for sprocket drive) have their centers in-line with the centers of the 5 code holes. In some European equipment, the feed holes have their leading edge in-line with the leading edge of the 5 code holes. Some 5-level paper tapes are 22.2 mm (7/8 inch) wide to allow room for printed characters along the edge of the tape. The wider tapes, or tapes with leading-edge feed holes, are not interchangeable with the tapes conforming to ANSI X3.19-1974.

There is no American National Standard for the representation of coded information in 5-level perforated tapes. Nevertheless, the coding conventions for the 26 Latin letters, 10 decimal digits, Period (.), Slant (/), Letters, Figures, Carriage Return, Line Feed, and Space are quite uniform. Optional symbols are used for communications, weather, and stock-market fractions.

5.4 Five-Bit Character Set. Fig. A2 shows the character sets for the 26 letters, 26 (or 27 for weather) other symbols, and 6 (5 for weather) common functions. These characters are represented by 32 patterns of the 5 information bits. The communication set is preferred to the weather set, or to the 1/8 to 7/8 fraction set found on stock-market teleprinters, since the communication set is comprised entirely of ASCII characters except for "Letters" and "Figures." There are eight (8) other characters that have different interpretations in the American variation of the 5-bit code than in the international CCITT ITA No. 2, 5-bit code. Surplus 5-bit teleprinters might vary in these 8 character positions, and hence it is recommended in this standard that these 8 Figures-shift characters not be used in interchangeable programs that are expected to be input or output via 5-bit teleprinters.

Only 50 characters are specified in the Fig. A2 translation table out of a possible 128 in 7-bit ASCII and 256 in 8-bit form. In interfacing microcomputers, it might be necessary to represent some or all of the 206 additional character positions through the medium of a 5-bit teleprinter. This standard provides an unambiguous means of accomplishing this by specifying a translation from 5-bit code to 4-bit (hexadecimal) code and by combining 2 hexadecimal characters into or from an 8-bit character representation.

5.5 Four-Bit Hexadecimal Representations in 5 Bits. This standard specifies that the 10 decimal digits shall be employed to represent the first 10 hexadecimal digits and that the other 6 be represented on 5-bit teleprinters by 6 graphic characters in "Figures" shift from the bottom row of the keyboard, starting with the key having the letter "X" (Roman Numeral 10) to represent the value "10," etc, as shown in Fig. A1. Note that the "Figures" shift corresponding to the letter "V" is used in the hexadecimal representation but not for character input/output since its representation is not the same on all 5-bit communication teleprinters, being either semicolon (;) or equal sign (=) as well as a fraction or weather symbol.

The transform between 5-Bit Code and 4-Bit Hexadecimal Code follows the same relationship in going from either code to the other. The relationship is shown in Fig. A3. The three formatting characters, CR, LF, and SPACE, are allowed in order to provide for easy-to-read tables of hexadecimal graphic symbols.

NOTE: Conventional hexadecimal representations employ the 10 decimal digits 0 through 9 and capital letters A through F to represent the 16 unique 4-bit patterns. If this convention were used with 5-bit teleprinters, it would be necessary to shift between "Figures" and "Letters" frequently. Furthermore, the digit "3" and the letter "E" employ the same bit pattern in 5-bits, ruling that technique out.

6. Seven-Bit Teleprinter Codes

6.1 ASCII Code. Most 7-bit surplus teleprinters employ the ASCII in accordance with ANSI X3.4-1977. The 1963 version did not specify lowercase alphabetic letters and had no "Backspace" function, but the later versions have both lowercase letters, Backspace, and other features. The 1963 code is shown in Fig. A4; the communal 1967, 1968, and 1977 code is shown in Fig. A5. Note that the 1963 ASCII has some control functions in column 7, whereas the subsequent version has no controls in column 7.

There are 128 character positions in the 7-bit ASCII Thirty-two are control functions; ninety-five, including "Space" (SP), are graphic characters; and the character with 7 "one" bits is called "Delete" (DEL). ASCII contains unique bit patterns for 52 letters, 10 decimal digits, and 32 special symbols, including common punctuation marks and business symbols. There is no "Cent Sign" in ASCII, but there is a "Dollar Sign" as well as all the other symbols and control functions deemed essential in general information interchange. The graphic symbol in column 7, row 12, is called "Vertical Line" in the 1967, 1968, and 1977 ASCII. In 1967 and 1968, it was shown as a broken vertical line. This was changed to a solid vertical line in 1977. Reference to the ASCII standard, ANSI 3.4-1977, is recommended for further details concerning the character set and bit-structure of ASCII.

6.2 Eight-Bit Microcomputer Interface Codes. Most microcomputers employ an 8-bit interface representation of ASCII, as shown in Fig. A6. That 8-bit representation has the eighth (high order) bit set to a value of "zero" for all of the ASCII characters, in accordance with ISO 2022-1973 or ANSI X3.41-1974. There is, thus, a direct correspondence between 7-bit teleprinter codes and one-half of the character positions used to interface most microcomputers.

6.3 Paper Tape of 25.4 mm (1 inch) Width. Paper tape of 25.4 mm (1 inch) width has 8 tracks of information holes in accordance with ANSI X3.6-1965 and ANSI X3.18-1974. If a parity bit is used in one-inch paper tape, it is even parity, with a parity bit in track 8. In some applications, it may be necessary to communicate between a 7-bit teleprinter, used as a console controller having a paper tape input/output device, and the 256 character positions of microcomputer interface, sometimes having a value of "one " in the high order bit position. It may be necessary for the implementor to change track 8 from a parity bit to a high order bit, which is unpunched for the 128 ASCII characters and punched for the 128 additional characters. A method of representing all 256 bit patterns is given in 4.4.

6.4 Hexadecimal Representation of 8-Bit Code. It would be possible to represent characters in columns 08 through 15 (of Fig. A6) by using the corresponding character in columns 00 through 07, along with an indication that the eighth (high order) bit should be set to "one." Many teleprinters, however, do not represent lowercase letters. Furthermore, the use of characters in columns 0 and 1 of ASCII could cause unwanted control functions to occur in the teleprinter. Hence, this standard specifies another choice of going into a 4-bit hexadecimal representation and combining two 4-bit characters into an 8-bit character. The method of relating the 4-bit and 8-bit codes is shown in Fig. A7 and A8. The conventional 0 through 9 and A through F notation is used. Note that capital letters are specified, even though this requires shifting to uppercase on the 4-row keyboards of 7-bit dual-case teleprinters. A typical 4-row teleprinter keyboard is shown in Fig. A9. Many 7-bit teleprinters are monocase, having only capital letters available; on these, the shifting is not required. (Many of these print capital letters if corresponding lowercase bit patterns are received.)

6.5 Serial-by-Bit 7-Bit Code. Seven-bit teleprinters generally send and receive a serial bit stream, with the low order bit (b_1) transmitted first in sequence through bit b_7, sometimes followed by an even parity bit, structured in accordance with ANSI X3.15-1976 (bit sequencing) and ANSI X3.16-1976 (character structure). The seven information bits (and the parity bit) may also be read out or into the teleprinter in parallel form instead of serially by bit.

6.6 Four-Bit Hexadecimal Code to 8-Bit Code. The standard method of relating 4-bit hexadecimal code to 8-bit character code is shown in Fig. A7. Track numbers in 1-inch paper tape correspond to the 8-bit numbers. Only 16 combinations of 4-bit numbers need be generated from a keyboard, along with three format effectors and an error correction pattern, as shown in Fig. A8.

Appendixes

(These Appendixes are not part of American National Standard X3.95-1982, but are included for information purposes only.)

Appendix A

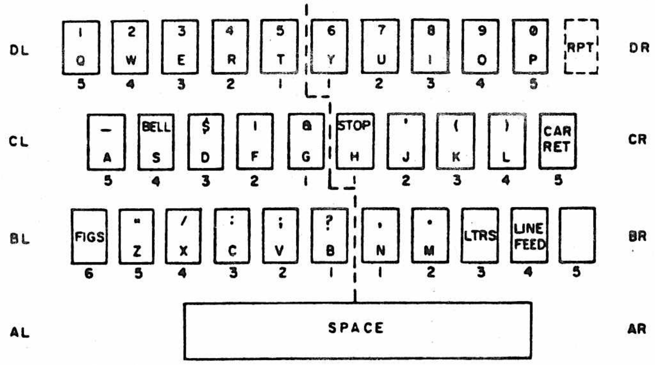
Illustrative Figures

Fig. A1 Three Row Keyboards
Fig. A2 International Telegraph Alphabet No. 2, American Variation
Fig. A3 Mapping between 4-Bit Hexadecimal and 5-Bit Teleprinter Code
Fig. A4 ASCII: 1963
Fig. A5 ASCII: 1967, 1968, and 1977
Fig. A6 Standard Representation of ASCII in 8 Bits
Fig. A7 Relationship of 8-Bit Code to 4-Bit Hexadecimal Code
Fig. A8 Mapping between 4-Bit Hexadecimal and 7-Bit Teleprinter Code
Fig. A9 Version of 4-Row ASCII Keyboard

Credits

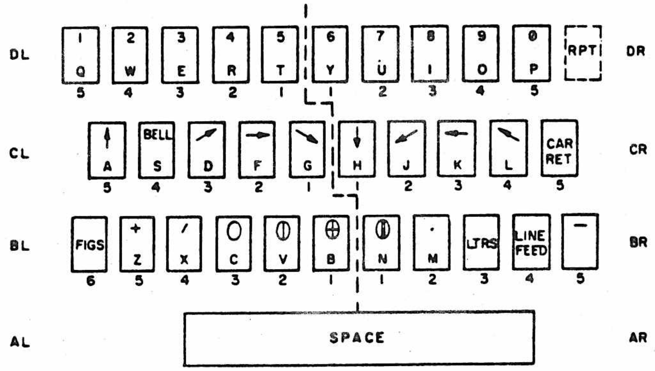
Fig. A1, A2, and A9 are taken from Military Communication System Technical Standards, U.S. Military Standard MIL-STD-188C, 24 November 1969.

Fig. A4 and A5 are from ANSI X3.4-1963 (no longer in print) and ANSI X3.4-1977, respectively.



NOTE: UPPER CASE H MAY BE STOP OR ≠

THREE ROW COMMUNICATION KEYBOARD (INTERIM STANDARD)



THREE ROW WEATHER KEYBOARD (INTERIM STANDARD)

Fig. A1
Three Row Keyboards

CHARACTERS			CODE SIGNALS							CCITT NO.2
LOWER CASE	UPPER CASE COMM	UPPER CASE WEATHER	START	1	2	3	4	5	STOP	UPPER CASE ✱
A	—	↑		▨	▨				▨	
B	?	⊕		▨			▨	▨	▨	
C	:	○			▨	▨	▨		▨	
D	$	↗		▨			▨		▨	WRU
E	3	3		▨					▨	
F	!	→		▨		▨	▨		▨	UNASSIGNED
G	&	↘			▨		▨	▨	▨	UNASSIGNED
H	STOP	↓				▨		▨	▨	UNASSIGNED
I	8	8			▨	▨			▨	
J	'	↙		▨	▨		▨		▨	AUDIBLE SIGNAL
K	(	←		▨	▨	▨	▨		▨	
L	)	↖			▨			▨	▨	
M	.	.				▨	▨	▨	▨	
N	,	⦷				▨	▨		▨	
O	9	9					▨	▨	▨	
P	0	0			▨	▨		▨	▨	
Q	1	1		▨	▨	▨		▨	▨	
R	→	4			▨		▨		▨	
S	BELL	BELL		▨		▨			▨	'(APOSTROPHE)
T	5	5						▨	▨	
U	7	7		▨	▨	▨			▨	
V	;	⦶			▨	▨	▨	▨	▨	=
W	2	2		▨	▨			▨	▨	
X	/	/		▨		▨	▨	▨	▨	
Y	6	6		▨		▨		▨	▨	
Z	"	+		▨				▨	▨	+
BLANK		—							▨	
SPACE						▨			▨	
CAR. RET.							▨		▨	
LINE FEED					▨				▨	
FIGURES				▨	▨		▨	▨	▨	
LETTERS				▨	▨	▨	▨	▨	▨	

NOTE: UPPER CASE H (COMM) MAY BE STOP OR #

▨ MARKING PULSE

☐ SPACING PULSE

✱ THIS COLUMN SHOWS ONLY THOSE CHARACTERS WHICH DIFFER FROM THE U.S.A. VARIATION

Fig. A2
International Telegraph Alphabet No. 2, American Variation

HEXADECIMAL		FIVE-BIT CODE		
4-BIT PATTERN	HEXADECIMAL VALUE	KEYTOP SYMBOL	PRINTING SYMBOL	5-BIT PATTERN
0000	0	0	0	01101
0001	1	1	1	11101
0010	2	2	2	11001
0011	3	3	3	10000
0100	4	4	4	01010
0101	5	5	5	00001
0110	6	6	6	10101
0111	7	7	7	11100
1000	8	8	8	01100
1001	9	9	9	00011
1010	10	X	/ (Slant)	10111
1011	11	C	: (Colon) or 1/8 or ○	01110
1100	12	V	; or = or 3/8 or ⦶	01111
1101	13	B	? (Question Mark) or 5/8 or ⊕	10011
1110	14	N	, (Comma) or 7/8 or ⦷	00110
1111	15	M	(Period)	00111
—	—	CR*	NONE	00010
—	—	LF*	NONE	01000
—	—	SPACE BAR*	NONE	00100
—	—	LETTERS	NONE	11111
—	—	FIGURES	NONE	11011

*These three characters are permitted in hexadecimal mode, in order to format tables of hexadecimal numbers into convenient groupings. "LETTERS" is permitted to delete errors in paper tape. "FIGURES" is permitted to return the printer to proper case shift.

Fig. A3
Mapping between 4-Bit Hexadecimal and 5-Bit Teleprinter Code

b4	b3	b2	b1								
			b7	0	0	0	0	1	1	1	1
			b6	0	0	1	1	0	0	1	1
			b5	0	1	0	1	0	1	0	1
0	0	0	0	NULL	DC_0	ƀ	0	@	P	UNASSIGNED	UNASSIGNED
0	0	0	1	SOM	DC_1	!	1	A	Q		
0	0	1	0	EOA	DC_2	"	2	B	R		
0	0	1	1	EOM	DC_3	#	3	C	S		
0	1	0	0	EOT	DC_4 (STOP)	$	4	D	T		
0	1	0	1	WRU	ERR	%	5	E	U		
0	1	1	0	RU	SYNC	&	6	F	V		
0	1	1	1	BELL	LEM	' (APOS)	7	G	W		
1	0	0	0	FE_0	S_0	(	8	H	X		
1	0	0	1	HT / SK	S_1	)	9	I	Y		
1	0	1	0	LF	S_2	*	:	J	Z		
1	0	1	1	V_{TAB}	S_3	+	;	K	[		
1	1	0	0	FF	S_4	, (COMMA)	<	L	\		ACK
1	1	0	1	CR	S_5	–	=	M	]		①
1	1	1	0	SO	S_6	.	>	N	↑		ESC
1	1	1	1	SI	S_7	/	?	O	←		DEL

1963 ASCII Legend

NULL	Null/Idle
SOM	Start of Message (CC)
EOA	End of Address (CC)
DC_0	Device control reserved for Data Link Escape
DC_1	Device Control 1
DC_2	Device Control 2
DC_3	Device Control 3
DC_4	Device Control 4 (Stop)
ERR	Error (CC)
EOM	End of Message (CC)
EOT	End of Transmission (CC)
WRU	"Who are you?" (CC)
RU	"Are you . . . ?" (CC)
BELL	Audible Signal
FE_0	Format Effector (FE)
HT	Horizontal Tabulation (FE)
SK	Skip (punched card) (FE)
LF	Line Feed (FE)

1963 ASCII Legend

V_{TAB}	Vertical Tabulation (FE)
FF	Form Feed (FE)
CR	Carriage Return (FE)
SO	Shift Out
SI	Shift In
SYNC	Synchronous Idle (CC)
LEM	Logical End of Media (CC)
S_0-S_7	Separator (information)
ƀ	Space (Word separator, normally nonprinting)
<	Less Than
>	Greater Than
↑	Up Arrow (Exponentiation)
←	Left Arrow (Implies/Replaced by)
\	Reverse Slant
ACK	Acknowledge (CC)
①	Unassigned Control
ESC	Escape
DEL	Delete Idle

NOTE: (CC) Communication Control; (FE) Format Effector.

Fig. A4
ASCII: 1963

b4	b3	b2	b1	COLUMN → / ROW ↓								
				b7	0	0	0	0	1	1	1	1
				b6	0	0	1	1	0	0	1	1
				b5	0	1	0	1	0	1	0	1
					0	1	2	3	4	5	6	7
0	0	0	0	0	NUL	DLE	SP	0	@	P	`	p
0	0	0	1	1	SOH	DC1	!	1	A	Q	a	q
0	0	1	0	2	STX	DC2	"	2	B	R	b	r
0	0	1	1	3	ETX	DC3	#	3	C	S	c	s
0	1	0	0	4	EOT	DC4	$	4	D	T	d	t
0	1	0	1	5	ENQ	NAK	%	5	E	U	e	u
0	1	1	0	6	ACK	SYN	&	6	F	V	f	v
0	1	1	1	7	BEL	ETB	'	7	G	W	g	w
1	0	0	0	8	BS	CAN	(	8	H	X	h	x
1	0	0	1	9	HT	EM	)	9	I	Y	i	y
1	0	1	0	10	LF	SUB	*	:	J	Z	j	z
1	0	1	1	11	VT	ESC	+	;	K	[	k	{
1	1	0	0	12	FF	FS	,	<	L	\	l	|
1	1	0	1	13	CR	GS	–	=	M	]	m	}
1	1	1	0	14	SO	RS	.	>	N	^	n	~
1	1	1	1	15	SI	US	/	?	O	_	o	DEL

1977 ASCII Legend

NUL	Null
SOH	Start of Heading (CC)
STX	Start of Text (CC)
ETX	End of Text (CC)
EOT	End of Transmission (CC)
ENQ	Enquiry (CC)
ACK	Acknowledge (CC)
BEL	Bell (audible or attention signal)
BS	Backspace (FE)
HT	Horizontal Tabulation (FE)
LF	Line Feed (FE)
VT	Vertical Tabulation (FE)
FF	Form Feed (FE)
CR	Carriage Return (FE)
SO	Shift Out
SI	Shift In
DLE	Data Link Escape (CC)

1977 ASCII Legend

DC1	Device Control 1
DC2	Device Control 2
DC3	Device Control 3
DC4	Device Control 4 (stop)
NAK	Negative Acknowledge (CC)
SYN	Synchronous Idle (CC)
ETB	End of Transmission Block (CC)
CAN	Cancel
EM	End of Medium
SUB	Substitute
ESC	Escape
FS	File Separator (IS)
GS	Group Separator (IS)
RS	Record Separator (IS)
US	Unit Separator (IS)
SP	Space
DEL	Delete

NOTE: (CC) Communication Control; (FE) Format Effector; (IS) Information Separator.

Fig. A5
ASCII: 1967, 1968, and 1977

BITS b8 b7 b6 b5 →					0 0 0 0	0 0 0 1	0 0 1 0	0 0 1 1	0 1 0 0	0 1 0 1	0 1 1 0	0 1 1 1	1 0 0 0	1 0 0 1	1 0 1 0	1 0 1 1	1 1 0 0	1 1 0 1	1 1 1 0	1 1 1 1
b4 ↓	b3 ↓	b2 ↓	b1 ↓	COLUMN → ROW ↓	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15
0	0	0	0	0	NUL	DLE	SP	0	@	P	`	p								
0	0	0	1	1	SOH	DC1	!	1	A	Q	a	q								
0	0	1	0	2	STX	DC2	"	2	B	R	b	r								
0	0	1	1	3	ETX	DC3	#	3	C	S	c	s								
0	1	0	0	4	EOT	DC4	$	4	D	T	d	t								
0	1	0	1	5	ENQ	NAK	%	5	E	U	e	u								
0	1	1	0	6	ACK	SYN	&	6	F	V	f	v								
0	1	1	1	7	BEL	ETB	'	7	G	W	g	w								
1	0	0	0	8	BS	CAN	(	8	H	X	h	x								
1	0	0	1	9	HT	EM	)	9	I	Y	i	y								
1	0	1	0	10	LF	SUB	*	:	J	Z	j	z								
1	0	1	1	11	VT	ESC	+	;	K	[	k	{								
1	1	0	0	12	FF	FS	,	<	L	\	l	|								
1	1	0	1	13	CR	GS	-	=	M	]	m	}								
1	1	1	0	14	SO	RS	.	>	N	^	n	~								
1	1	1	1	15	SI	US	/	?	O	_	o	DEL								

Fig. A6
Standard Representation of ASCII in 8 Bits

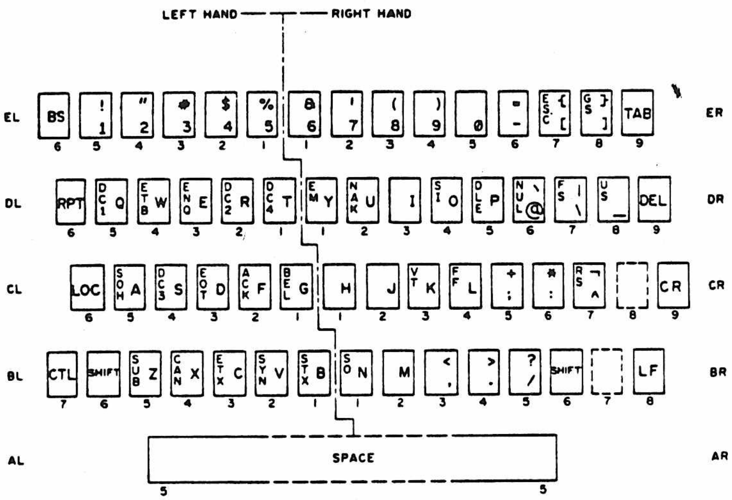
	High Order				Low Order			
Binary Weight (8-Bit)	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
Bit Numbers (8-Bit)	b_8	b_7	b_6	b_5	b_4	b_3	b_2	b_1
Bit Numbers (4-Bit)	b_4	b_3	b_2	b_1	b_4	b_3	b_2	b_1
Binary Weight (4-Bit)	2^3	2^2	2^1	2^0	2^3	2^2	2^1	2^0
Hexadecimal Sequence	First				Second			

Fig. A7
Relationship of 8-Bit Code to 4-Bit Hexadecimal Code

HEXADECIMAL		ASCII		
4-BIT PATTERN	HEXADECIMAL VALUE	KEYTOP SYMBOL	PRINTING SYMBOL	7-BIT PATTERN
0000	0	0	0	0110000
0001	1	1	1	0110001
0010	2	2	2	0110010
0011	3	3	3	0110011
0100	4	4	4	0110100
0101	5	5	5	0110101
0110	6	6	6	0110110
0111	7	7	7	0110111
1000	8	8	8	0111000
1001	9	9	9	0111001
1010	10	A	A	1000001
1011	11	B	B	1000010
1100	12	C	C	1000011
1101	13	D	D	1000100
1110	14	E	E	1000101
1111	15	F	F	1000110
—	—	CR*	NONE	0001101
—	—	LF*	NONE	0001010
—	—	SPACE BAR*	NONE	0100000
—	—	RUB OUT OR DELETE	NONE	1111111

*These three characters (CR, LF, SP) are permitted in hexadecimal mode, in order to format tables of hexadecimal numbers into convenient groupings. "DELETE" is permitted in order to punch out errors in paper tape.

Fig. A8
Mapping between 4-Bit Hexadecimal and 7-Bit Teleprinter Code


LEFT HAND
RIGHT HAND
EL
ER
DL
DR
CL
CR
BL
BR
AL
AR
BS ! 1 " 2 # 3 $ 4 % 5 & 6 ' 7 (8) 9 0 = - ESC { [GS }] TAB
RPT DC1 Q ETB W ENQ E DC2 R DC4 T EM Y NAK U I SI O DLE P NUL \ @ FS | \ US _ DEL
LOC SOH A DC3 S EOT D ACK F BEL G H J VT K FF L + ; * : RS ¬ ^ CR
CTL SHIFT SUB Z CAN X ETX C SYN V STX B SO N M < , > . ? / SHIFT LF
SPACE

NOTES:

(1) Physical characteristics and locations (i.e., size, shape, skew, etc) of space bar or keys are not to be inferred.

(2) Arrangement Type I, Class 1, as per MIL-STD-1280.

Fig. A9
Version of 4-Row ASCII Keyboard
(Not Representative of Current Standards)

Appendix B
Historical Background

B1. Early Automatic Telegraphy

The encoding of character-oriented information into binary bit patterns is as old as automatic telegraphy, or a little more than a century old. Automatic telegraphy employed the same number of bits for all characters, unlike the earlier Morse codes used in manual telegraphy. Early automatic telegraphy employed, usually, 5 bits per character, and this evolved through the International Telegraph Union into what is now known as the CCITT International Telegraph Alphabet No. 2 (ITA 2). In ITA 2, the 5-bit structure provides 32 bit patterns. Twenty-six of these patterns are assigned dual interpretations such as digits and letters. Two of the remaining six serve as the precedence characters known as "Letters" and "Figures." The other four represent "Space," "Carriage Return," "Line Feed," and (usually) "Blank Tape," regardless of whether the previous shift was "Letters" or "Figures."

B2. Early Electronic Digital Computers

Early electronic digital computers, in the 1950s decade, generally employed 6 bits for each character. No precedence characters were employed, because of the necessity to have the interpretation of a bit pattern independent of any previously occurring bit pattern (in a time or string sense).

There was a great proliferation of character codes in the 1950-1960 decade. In the early 1960s, development of a standard character code was begun and an attempt was made to limit it to 6 bits. This was deemed to be inadequate, however, and the first version of the American National Standard Code for Information Interchange (ASCII) appeared in 1963 as ANSI X3.4-1963. The 1963 ASCII was 7 bits per character, but with no lowercase alphabet defined, pending a decision as to whether to "Shift Out" and "Shift In" for the dual alphabets or whether to assign independent bit patterns. The 1963 ASCII served as a prototype international standard. Subsequently, the decision was made by the International Organization for Standardization (ISO) to assign lowercase letters to independent bit patterns (in an early edition of a standard, ISO 646-1967), since that is much the preferred scheme for representing alphabetic characters in computers. ASCII followed the lead, and the 1967 and 1968 editions of ANSI X3.4 used 52 bit patterns to represent letters. The CCITT and ISO agreed on a nearly common document so that CCITT International Alphabet No. 5 is the same as the International Reference Version in ISO 646-1973.

B3. Advancing Character Code Standards

While character code standards were advancing from 5 bits to 7 bits per character, digital computer representations almost universally advanced from 6 bits to 8 bits per character. A unique representation of ASCII in 8 bits appeared in the IBM System 360 computers as an alternate to the 8-bit Extended Binary Coded Decimal Interchange Code (EBCDIC). The national standards, however, adopted a simpler 8-bit ASCII representation, which first appeared in an earlier edition of the magnetic tape standard ANSI X3.14-1973. In all subsequent 8-bit representations of 7-bit ASCII characters, the eighth bit is considered to be the high order bit and is set to a value of "zero" for all of the ASCII characters (and to a value of "one" for an additional 128 non-ASCII characters).

B4. Minicomputers

Many minicomputers were developed during the late 1960s and 1970s with ASCII as the internal code in either 7-bit or 8-bit forms. Microcomputers were developed during the 1970s. Most microcomputers employ 8 bits per character and use ASCII in the standard manner as the low order 7 bits of these 8-bit characters.

B5. Microcomputers for Hobbyists

Microcomputers dropped the cost of computers to the extent that their price of a few hundred dollars put them into the reach of hobbyists; in the mid-1970s, they began to flourish as hobby devices. Hobbyists immediately discovered that a suitable console device for their microcomputer usually cost more than the computer. Surplus 5-bit and 7-bit teleprinters were in abundance, at a price, but no uniform technique was known for mapping the 5-bit codes into and out of the 8-bit environment of the microcomputers. This standard was developed to provide uniformity, so that the translation logic can be designed into integrated circuit chips and, by mass production, bring the cost within reach of the computer hobbyist.

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INTERNATIONAL STANDARD

ISO/IEC 646

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Third edition
1991-12-15

Information technology — ISO 7-bit coded character set for information interchange

Technologies de l'information — Jeu ISO de caractères codés à 7 éléments pour l'échange d'informations

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Foreword

ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission) form the specialized system for worldwide standardization. National bodies that are members of ISO or IEC participate in the development of International Standards through technical committees established by the respective organization to deal with particular fields of technical activity. ISO and IEC technical committees collaborate in fields of mutual interest. Other international organizations, governmental and non-governmental, in liaison with ISO and IEC, also take part in the work.

In the field of information technology, ISO and IEC have established a joint technical committee, ISO/IEC JTC 1. Draft International Standards adopted by the joint technical committee are circulated to national bodies for voting. Publication as an International Standard requires approval by at least 75 % of the national bodies casting a vote.

International Standard ISO/IEC 646 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*.

This third edition cancels and replaces the second edition (ISO 646 : 1983) which has been technically revised.

Annex A forms an integral part of this International Standard. Annexes B and C are for information only.

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INTERNATIONAL STANDARD

ISO/IEC 646 : 1991 (E)

Information technology — ISO 7-bit coded character set for information interchange

1 Scope

This International Standard specifies a set of 128 characters, (control characters and graphic characters such as letters, digits and symbols) with their coded representation. Most of these characters are mandatory and unchangeable, but provision is made for some flexibility to accommodate national and other requirements.

This International Standard specifies a 7-bit coded character set with a number of options. It also provides guidance on how to exercise the options to define specific national versions and application-oriented versions. Furthermore it specifies the International Reference Version (IRV) in which such options have been exercised.

This character set is primarily intended for the interchange of information among data processing systems and associated equipment, and within data communication systems. The need for graphic characters and control functions in data processing has also been taken into account in determining this character set.

This character set is applicable to alphabets of the Latin script.

This character set allows the use of control characters for code extension where its character set is insufficient for particular applications. Procedures for the use of these control characters are specified in ISO 2022.

The definitions of the control characters mentioned in this International Standard are specified in ISO 6429. It is assumed that data associated with them are to be processed serially in a forward direction. When they are included in strings of data which are processed other than serially in a forward direction or when they are included in data formatted for fixed-record processing they may have undesirable effects or may require additional special treatment to ensure that they result in their desired function.

2 Conformance and implementation

2.1 Conformance

2.1.1 Conformance of information interchange

A coded-character-data-element (CC-data-element) within coded information for interchange is in conformance with this International Standard if all the coded representations of characters within that CC-data-element conform to the requirements of 8.1 of this International Standard.

A claim of conformance shall identify the version adopted in accordance with 8.2 to 8.4.

2.1.2 Conformance of devices

A device is in conformance with this International Standard if it conforms to the requirements of 2.1.2.1, and either or both of 2.1.2.2 and 2.1.2.3 below. A claim of conformance shall identify the version adopted

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2.1.2.1 Device description

A device that conforms to this International Standard shall be the subject of a description that identifies the means by which the user may supply characters to the device, or may recognize them when they are made available to him, as specified respectively in 2.1.2.2 and 2.1.2.3.

2.1.2.2 Originating devices

An originating device shall allow its user to supply any sequence of characters from the version adopted, and shall be capable of transmitting their coded representations within a CC-data-element.

2.1.2.3 Receiving devices

A receiving device shall be capable of receiving and interpreting any coded representations of characters that are within a CC-data-element, and that conform to 2.1.1, and shall make the corresponding characters available to its user in such a way that the user can identify them from among those of the version adopted, and can distinguish them from each other.

2.2 Implementation

The use of this character set requires definitions of its implementation in various media. For example, these could include punched tapes, punched cards, magnetic and optical interchangeable media and transmission channels, thus permitting interchange of data to take place either indirectly by means of an intermediate recording on a physical medium, or by local connection of various units (such as input and output devices and computers) or by means of data transmission equipment.

The implementation of this coded character set in physical media and for transmission, taking into account the need for error checking, is the subject of other International Standards.

3 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards listed below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 2022 : 1986, *Information processing - ISO 7-bit and 8-bit coded character sets - Code extension techniques.*

ISO/IEC 6429 : 1), *Information processing - Control functions for 7-bit and 8-bit coded character sets.*

4 Definitions

For the purpose of this International Standard the following definitions apply.

4.1 active position : The character position which is to image the graphic symbol representing the next graphic character or relative to which the next control function is to be executed.

NOTE 1 - In general, the active position is indicated in a display by a cursor.

4.2 bit combination : An ordered set of bits used for the representation of characters.

4.3 character : A member of a set of elements used for the organization, control or representation of data.

4.4 character position : The portion of a display that is imaging or is capable of imaging a graphic symbol.

4.5 coded character set; code : A set of unambiguous rules that establishes a character set and the one-to-one relationship between the characters of the set and their bit combinations.

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1) To be published.

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4.6 coded-character-data-element (CC-data-element) : An element of interchanged information that is specified to consist of a sequence of coded representations of characters, in accordance with one or more identified standards for coded character sets.

NOTE 2 - In a communication environment according to the Reference Model for Open Systems Interconnection (ISO 7498), a CC-data element will form all or part of the information that corresponds to the Presentation - Protocol -Data - Unit (PPDU) defined in that International Standard.

NOTE 3 - When information interchange is accomplished by means of interchangeable media, a CC-data-element will form all or part of the information that corresponds to the user data, and not that recorded during formatting and initialization.

4.7 code extension : The techniques for the encoding of characters that are not included in the character set of a given code.

4.8 code table : A table showing the character allocated to each bit combination in a code.

4.9 control character : A control function the coded representation of which consists of a single bit combination.

4.10 control function : An action that affects the recording, processing, transmission, or interpretation of data, and that has a coded representation consisting of one or more bit combinations.

4.11 device : A component of information processing equipment which can transmit, and/or receive, coded information within CC-data-elements.

NOTE 4 - It may be an input/output device in the conventional sense, or a process such as an application program or gateway function.

4.12 escape sequence : A string of bit combinations that is used for control purposes in code extension procedures. The first of these bit combinations represents the control function ESCAPE.

4.13 Final Byte : The bit combination that terminates an escape sequence or a control sequence.

4.14 graphic character : A character, other than a control function, that has a visual representation normally handwritten, printed or displayed, and that has a coded representation consisting of one or more bit combinations.

4.15 graphic symbol : A visual representation of a graphic character or of a control function.

4.16 repertoire : A specified set of characters that are represented by means of one or more bit combinations of a coded character set.

4.17 user : A person or other entity that invokes the services provided by a device.

NOTE 5 - This entity may be a process such as an application program if the "device" is a code convertor or a gateway function, for example.

NOTE 6 - The characters, as supplied by the user or made available to him, may be in the form of codes local to the device, or of non-conventional visible representations, provided that 2.1.2 above is satisfied.

5 Notation, code table and names

5.1 Notation

The bits of the bit combinations of the 7-bit code are identified by b_7, b_6, b_5, b_4, b_3, b_2 and b_1, where b_7 is the highest-order, or most-significant, bit and b_1 is the lowest order, or least-significant, bit.

The bit combinations may be interpreted to represent integers in the range 0 to 127 in binary notation by attributing the following weights to the individual bits:

Bit :	b_7	b_6	b_5	b_4	b_3	b_2	b_1
Weight :	64	32	16	8	4	2	1

In this International Standard, the bit combinations are identified by notations of the form x/y, where x is a number in the range 0 to 7 and y is a number in the range 0 to 15. The correspondence between the notations of the form x/y and the bit combinations consisting of the bits b_7 to b_1 is as follows:

- x is the number represented by b_7, b_6 and b_5 where these bits are given the weights 4, 2 and 1 respectively.
- y is the number represented by b_4, b_3, b_2 and b_1 where these bits are given the weights 8, 4, 2 and 1 respectively.

The notations of the form x/y are the same as those used to identify code table positions, where x is the column number and y the row number (see 5.2).

5.2 Code table

A 7-bit code table consists of 128 positions arranged in 8 columns and 16 rows. The columns are numbered 0 to 7 and the rows 0 to 15.

The code table positions are identified by notations of the form x/y, where x is the column number and y is the row number.

The positions of the code table are in one-to-one correspondence with the bit combinations of the code. The notation of a code table position, of the form x/y, is the same as that of the corresponding bit combination.

5.3 Names

This International Standard assigns one name to each character. In addition, it specifies an acronym for each control character and for the characters SPACE and DELETE, and a graphic symbol for each graphic character. By convention, only capital letters, space and hyphen are used for writing the names of the characters. For acronyms only capital letters and digits are used. It is intended that the acronyms and this convention be retained in all translations of the text.

The names chosen to denote graphic characters are intended to reflect their customary meaning. However, this International Standard does not define and does not restrict the meanings of graphic characters. Neither does it specify a particular style or font design for the graphic characters when imaged.

6 Specification of the coded character set

6.1 Structure

The coded character set of this International Standard shall have the following structure.

- a C0 control character set of up to 32 control characters;
- the graphic character SPACE (SP).
- a G0 graphic character set of up to 94 graphic characters;
- the character DELETE (DEL).

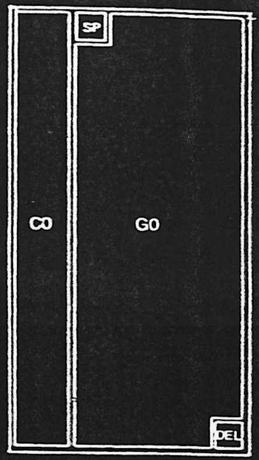

Figure 1 - Structure of the 7-bit coded character set

6.2 Control characters

The control characters of the C0 set shall be represented by bit combinations as specified in annex A.

6.3 Character SPACE

The acronym of the character SPACE is SP and it is represented by bit combination 2/0.

This character is a graphic character, it has a visual representation consisting of the absence of a graphic symbol.

6.4 Graphic characters

The 94 bit combinations 2/1 to 7/14 are used for the representation of graphic characters as specified in 6.4.1, 6.4.2 and 6.4.3.

All graphic characters shall be spacing characters, that is, they cause the active position to advance by one character position.

6.4.1 Unique graphic character allocations

A unique graphic character is allocated to each of the 82 bit combinations 2/1, 2/2, 2/5 to 3/15, 4/1 to 5/10, 5/15 and 6/1 to 7/10. These graphic characters are specified in table 1.

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Table 1 - Unique graphic character allocations

Graphic Symbol	Name	Coded representation
!	EXCLAMATION MARK	2/1
"	QUOTATION MARK	2/2
%	PERCENT SIGN	2/5
&	AMPERSAND	2/6
'	APOSTROPHE	2/7
(	LEFT PARENTHESIS	2/8
)	RIGHT PARENTHESIS	2/9
*	ASTERISK	2/10
+	PLUS SIGN	2/11
,	COMMA	2/12
-	HYPHEN-MINUS	2/13
.	FULL STOP	2/14
/	SOLIDUS	2/15
0	DIGIT ZERO	3/0
1	DIGIT ONE	3/1
2	DIGIT TWO	3/2
3	DIGIT THREE	3/3
4	DIGIT FOUR	3/4
5	DIGIT FIVE	3/5
6	DIGIT SIX	3/6
7	DIGIT SEVEN	3/7
8	DIGIT EIGHT	3/8
9	DIGIT NINE	3/9
:	COLON	3/10
;	SEMICOLON	3/11
<	LESS-THAN SIGN	3/12
=	EQUALS SIGN	3/13
>	GREATER-THAN SIGN	3/14
?	QUESTION MARK	3/15
A	LATIN CAPITAL LETTER A	4/1
B	LATIN CAPITAL LETTER B	4/2
C	LATIN CAPITAL LETTER C	4/3
D	LATIN CAPITAL LETTER D	4/4
E	LATIN CAPITAL LETTER E	4/5
F	LATIN CAPITAL LETTER F	4/6
G	LATIN CAPITAL LETTER G	4/7
H	LATIN CAPITAL LETTER H	4/8
I	LATIN CAPITAL LETTER I	4/9
J	LATIN CAPITAL LETTER J	4/10
K	LATIN CAPITAL LETTER K	4/11
L	LATIN CAPITAL LETTER L	4/12
M	LATIN CAPITAL LETTER M	4/13
N	LATIN CAPITAL LETTER N	4/14
O	LATIN CAPITAL LETTER O	4/15
P	LATIN CAPITAL LETTER P	5/0
Q	LATIN CAPITAL LETTER Q	5/1
R	LATIN CAPITAL LETTER R	5/2
S	LATIN CAPITAL LETTER S	5/3

(continued)

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Table 1 - Unique graphic character allocations

Graphic Symbol	Name	Coded representation
T	LATIN CAPITAL LETTER T	5/4
U	LATIN CAPITAL LETTER U	5/5
V	LATIN CAPITAL LETTER V	5/6
W	LATIN CAPITAL LETTER W	5/7
X	LATIN CAPITAL LETTER X	5/8
Y	LATIN CAPITAL LETTER Y	5/9
Z	LATIN CAPITAL LETTER Z	5/10
_	LOW LINE	5/15
a	LATIN SMALL LETTER A	6/1
b	LATIN SMALL LETTER B	6/2
c	LATIN SMALL LETTER C	6/3
d	LATIN SMALL LETTER D	6/4
e	LATIN SMALL LETTER E	6/5
f	LATIN SMALL LETTER F	6/6
g	LATIN SMALL LETTER G	6/7
h	LATIN SMALL LETTER H	6/8
i	LATIN SMALL LETTER I	6/9
j	LATIN SMALL LETTER J	6/10
k	LATIN SMALL LETTER K	6/11
l	LATIN SMALL LETTER L	6/12
m	LATIN SMALL LETTER M	6/13
n	LATIN SMALL LETTER N	6/14
o	LATIN SMALL LETTER O	6/15
p	LATIN SMALL LETTER P	7/0
q	LATIN SMALL LETTER Q	7/1
r	LATIN SMALL LETTER R	7/2
s	LATIN SMALL LETTER S	7/3
t	LATIN SMALL LETTER T	7/4
u	LATIN SMALL LETTER U	7/5
v	LATIN SMALL LETTER V	7/6
w	LATIN SMALL LETTER W	7/7
x	LATIN SMALL LETTER X	7/8
y	LATIN SMALL LETTER Y	7/9
z	LATIN SMALL LETTER Z	7/10

6.4.2 Alternative graphic character allocations

Two alternative graphic characters are allocated to each of the bit combinations 2/3 and 2/4. These characters are specified in table 2

Table 2 - Alternative graphic character allocations

Graphic Symbol	Name	Coded representation
#	NUMBER SIGN	2/3
£	POUND SIGN	2/3
$	DOLLAR SIGN	2/4
¤	CURRENCY SIGN	2/4

Either the character NUMBER SIGN or the character POUND SIGN shall be allocated to bit combination 2/3 and either the character DOLLAR SIGN or the character CURRENCY SIGN shall be allocated to bit combination 2/4 (see clause 8).

Unless otherwise agreed between sender and recipient, the graphic symbols £, $ and ¤ do not designate the currency of a specific country.

6.4.3 National or application-oriented graphic character allocations

No specific graphic character is allocated to the ten bit combinations 4/0, 5/11 to 5/14, 6/0 and 7/11 to 7/14. These bit combinations are available for national or application-oriented use. Either a unique graphic character shall be allocated to each of these bit combinations, or the bit combination shall be declared unused (see 8.1).

6.5 Character DELETE

The acronym of the character DELETE is DEL and it is represented by bit combinationat 7/15. DEL was originally used to erase or obliterate an erroneous or unwanted character in punched tape. DEL may be used for media-fill or time-fill. DEL characters may be inserted into, or removed from, a data stream without affecting the information content of that stream, but such action may affect the information layout and/or the control of equipment.

7 Composite graphic characters

Whilst all graphic characters specified in this International Standard are spacing characters, it is possible, by using BACKSPACE or CARRIAGE RETURN to image two or more graphic characters at the same character position (see also clause B.2 of annex B).

For example, SOLIDUS and EQUALS SIGN may be combined to image "not equals". The character LOW LINE, that may be used as a free-standing character, may also be associated with other character(s) to represent the graphic rendition "underlined".

Diacritical marks may be allocated to the bit combinations specified in 6.4.3 and be available for composing accented letters. For such composition a sequence of three characters, the first or last of which is the letter to be accented and the second of which is BACKSPACE may be used. Furthermore, QUOTATION MARK, APOSTROPHE or COMMA can be associated with a letter by means of BACKSPACE for the composition of an accented letter with a diaeresis, an acute accent or a cedilla, respectively.

8 Versions of the coded character set

8.1 General

In order to use the 7-bit coded character set for information interchange, it is necessary to exercise the options left open in clause 6

- to specify the C0 set of control characters according to annex A.
- to specify the G0 set:
    - to allocate to each of the bit combinations 2/3 and 2/4 one of the alternative graphic characters specified in 6.4.2,
    - to allocate to each of the bit combinations 4/0, 5/11 to 5/14, 6/0, and 7/11 to 7/14 a unique graphic character, or to declare the bit combination unused.

A graphic character allocated to a bit combination specified in 6.4.1 and 6.4.2 shall not be allocated to any other bit combination. For example, the POUND SIGN, if not allocated to bit combination 2/3, shall not be allocated to any other bit combination.

A character set completed in this way is called a "version of ISO 646".

Such a version will generally be the subject of a specification document which states how the above options have been exercised. Such a specification is said to be in accordance with this International Standard.

8.2 International Reference Version (IRV)

This version is available for use when there is no requirement to use a national or an application-oriented version. In information interchange, the IRV is assumed unless an agreement exists between sender and recipient of the data (see also clause 10). The graphic characters allocated to the G0 set of the IRV shall be as specified in tables 1 and 3. Agreement between sender and recipient of the data shall be required if composite characters are used.

If the C0 set of the IRV is used, it shall be as specified in clause A.2 of annex A.

Table 3 - IRV graphic character allocations

Graphic Symbol	Name	Coded representation
#	NUMBER SIGN	2/3
$	DOLLAR SIGN	2/4
@	COMMERCIAL AT	4/0
[	LEFT SQUARE BRACKET	5/11
\	REVERSE SOLIDUS	5/12
]	RIGHT SQUARE BRACKET	5/13
^	CIRCUMFLEX ACCENT	5/14
`	GRAVE ACCENT	6/0
{	LEFT CURLY BRACKET	7/11
|	VERTICAL LINE	7/12
}	RIGHT CURLY BRACKET	7/13
~	TILDE	7/14

8.3 National versions

8.3.1 The responsibility for defining national versions lies with the national standardization bodies. These bodies shall exercise the options available and make the required selection (see annex B).

8.3.2 If so required, more than one national version can be defined within a country. The different versions shall be separately identified. In particular, when alternative graphic characters are required, for a given bit combination, for example 5/12, two different versions shall be identified, even if they differ only by this single character.

8.3.3 If, in a country, there is no special demand for specific graphic characters, it is strongly recommended that the characters of the G0 set of the International Reference Version (IRV) be selected and allocated to the same bit combinations as in the IRV.

However, when graphic characters that are different from the characters of the IRV are required, they shall have distinct forms and be given distinctive names which are not in conflict with any of the forms or the names of any of the graphic characters in the IRV.

V
S
M
F
7
0
8

8.4 Application-oriented versions

Within national or international industries, organizations or professional groups, application-oriented versions may be used. They require precise agreement among the interested parties, who will have to exercise the options available and to make the required selection.

9 Identification of versions

9.1 Purpose and context of identification

CC-data-elements conforming to a version of this International Standard are intended to form all or part of a composite unit of coded information that is interchanged between an originator and a recipient. The identification of the version of this International Standard that has been adopted by the originator shall also be available to the recipient. The route by which such identification is communicated to the recipient is outside the scope of this International Standard.

However, some standards for interchange of coded information may permit, or require, that the coded representation of the identification applicable to the CC-data-elements forms a part of the interchanged information. This clause specifies a coded representation for the identification of a version of this International Standard. Such coded representations form all or part of an identifying data element, which may be included in information interchange in accordance with the relevant standard.

9.2 Identification of a version

The identification of a version of this International Standard shall comprise a set of identifications, one for the C0 set and G0 set that constitute the version. Each identification in the set shall consist of a designating escape sequence of the type shown below.

ESC 2/1 F shall identify the C0 set.
ESC 2/8 F shall identify the G0 set.

The final byte F of these escape sequence shall be obtained from the International Register ISO 2375. If the C0 set is empty, the identification shall be the same escape sequence in which the final byte F is 7/14.

The IRV shall be identified by the following escape sequences:

For the C0 set, if provided, by Registration ISO IR No. 1 : ESC 2/1 4/0

For the C0 set, if not provided, by ESC 2/1 7/14

For the G0 set by Registration ISO IR No. 6 : ESC 2/8 4/2

10 Explanation of Code tables No. 4 and No. 5

Table 4 is the basic 7-bit code table. It shows the 7-bit coded character set specified in clause 5 and indicates the options related to alternative graphic characters (6.4.2) and national or application-oriented use (6.4.3).

Bit combinations 0/0 to 1/15 are reserved for control characters and are shown empty. Bit combinations 2/0 to 7/15 represent a graphic symbol, an acronym, or a reference to a clause of this International Standard. A reference to 6.4.2 and 6.4.3 is denoted by ① or ②, respectively.

Table 5 is a code table showing a version which includes the G0 set of the IRV and no C0 set.

V
S
M
F
7
0
9

Table 4 - Basic code table

				b7	0	0	0	0	1	1	1	1
				b6	0	0	1	1	0	0	1	1
				b5	0	1	0	1	0	1	0	1
b4	b3	b2	b1		0	1	2	3	4	5	6	7
0	0	0	0	0			SP	0	②	P	②	p
0	0	0	1	1			!	1	A	Q	a	q
0	0	1	0	2			"	2	B	R	b	r
0	0	1	1	3			# / ① £	3	C	S	c	s
0	1	0	0	4			¤ / ① $	4	D	T	d	t
0	1	0	1	5			%	5	E	U	e	u
0	1	1	0	6			&	6	F	V	f	v
0	1	1	1	7			'	7	G	W	g	w
1	0	0	0	8			(	8	H	X	h	x
1	0	0	1	9			)	9	I	Y	i	y
1	0	1	0	10			*	:	J	Z	j	z
1	0	1	1	11			+	;	K	②	k	②
1	1	0	0	12			,	<	L	②	l	②
1	1	0	1	13			-	=	M	②	m	②
1	1	1	0	14			.	>	N	②	n	②
1	1	1	1	15			/	?	O	_	o	DEL

C0 Set

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Table 5 - Version with the G0 set of the IRV

				b7	0	0	0	0	1	1	1	1
				b6	0	0	1	1	0	0	1	1
				b5	0	1	0	1	0	1	0	1
					0	1	2	3	4	5	6	7
b4	b3	b2	b1									
0	0	0	0	0			SP	0	@	P	\`	p
0	0	0	1	1			!	1	A	Q	a	q
0	0	1	0	2			"	2	B	R	b	r
0	0	1	1	3			#	3	C	S	c	s
0	1	0	0	4			$	4	D	T	d	t
0	1	0	1	5			%	5	E	U	e	u
0	1	1	0	6			&	6	F	V	f	v
0	1	1	1	7			'	7	G	W	g	w
1	0	0	0	8			(	8	H	X	h	x
1	0	0	1	9			)	9	I	Y	i	y
1	0	1	0	10			*	:	J	Z	j	z
1	0	1	1	11			+	;	K	[	k	{
1	1	0	0	12			,	<	L	\\	l	|
1	1	0	1	13			-	=	M	]	m	}
1	1	1	0	14			.	>	N	^	n	~
1	1	1	1	15			/	?	O	_	o	DEL

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Annex A

(normative)

Specification of the C0 set

A.1 C0 set of a version of ISO/IEC 646

The C0 set of a version of ISO/IEC 646 shall be a sub set of the C0 set of ISO/IEC 6429. The selected control functions shall be used according to their definitions in ISO/IEC 6429. Bit combinations corresponding to control functions not selected shall be declared unused.

A.2 C0 set of the IRV

If the C0 set of the International Reference Version (IRV) is used, it shall be the C0 set of ISO/IEC 6429.

A.3 Table A.1

Table A.1 shows, for convenience, the C0 set of ISO/IEC 6429. For the definition of these control functions see ISO/IEC 6429.

Table A.1 - C0 set of ISO/IEC 6429

				b7	0	0
				b6	0	0
				b5	0	1
					0	1
b4	b3	b2	b1			
0	0	0	0	0	NUL	DLE
0	0	0	1	1	SOH	DC1
0	0	1	0	2	STX	DC2
0	0	1	1	3	ETX	DC3
0	1	0	0	4	EOT	DC4
0	1	0	1	5	ENQ	NAK
0	1	1	0	6	ACK	SYN
0	1	1	1	7	BEL	ETB
1	0	0	0	8	BS	CAN
1	0	0	1	9	HT	EM
1	0	1	0	10	LF	SUB
1	0	1	1	11	VT	ESC
1	1	0	0	12	FF	IS.
1	1	0	1	13	CR	IS.
1	1	1	0	14	SO	IS.
1	1	1	1	15	SI	IS.

V S M F

Annex B
(informative)

Guidelines for standards derived from ISO/IEC 646

B.1 General

When drafting national or application-orientated standards based on ISO/IEC 646, it is recommended that the following considerations be taken into account.

B.2 Structure of a standard

It is recommended that the same structure and editorial style as implemented for ISO/IEC 646 be adopted. All facilities, restrictions and specifications of the standard should be stated clearly in sentences using plain language, rather than being summarized in tables with notes.

B.2.1 Control functions

The standard should contain the selection of control characters from the C0 set of ISO/IEC 6429 and an explicit description of the corresponding control functions. Even where the descriptions are identical with those of ISO/IEC 6429, they should be stated explicitly, and not merely by reference to ISO/IEC 6429. For application-oriented standards the specific meaning of the Information Separators and of the Device Controls should be defined.

B.2.2 Graphic characters (see 8.3.3)

Where there is no need for particular characters, the graphic characters of the International Reference Version (IRV) should be allocated to the same bit combinations and with the same names as in ISO/IEC 646.

B.2.3 Composite graphic characters and repertoire

ISO/IEC 646 permits the construction of composite graphic characters by using the control characters BACKSPACE and CARRIAGE RETURN to image two or more graphic characters at the same character position.

The total number of graphic characters which can be obtained from any version of the character set, with or without using this facility, is called the repertoire. ISO/IEC 646 does not define a particular repertoire. However, as the interpretation and/or the imaging of composite characters may cause difficulties, agreement between sender and recipient of the data may be required. To minimize the need for such agreements and to facilitate interchange, national or application-oriented standards may specify a standard repertoire of graphic characters which permit only a limited number of composite graphic characters. Such limitations are considered fully compatible with ISO/IEC 646.

B.2.4 Versions

In a standard, one or more versions can be specified. It should be noted that a version is not a standard but only part of a standard. The standard itself consists of the C0 set and the well-defined version or versions and a set of clauses as mentioned above. The definition of a version requires that the options mentioned in 8.1 be properly exercised.

7 1 2

V S M F

Annex C
(informative)

Differences between the second edition (1983) and the present (third) edition of this International Standard

C.1 The new text for the conformance clause adopted by JTC1/SC2 for all code standards has been introduced.

C.2 The wording of all definitions has been aligned with that of ISO/IEC 4873 and ISO/IEC 10538.

C.3 In the G0 set of the IRV the character DOLLAR SIGN replaces the character CURRENCY SIGN in position 2/4. Otherwise this G0 set is unchanged.

C.4 The requirements for the C0 set have been relaxed. The sole requirement is that the C0 set be a subset of the C0 set of the second edition of this International Standard. This C0 set is shown in normative annex A. For the definitions of the 32 control characters reference is made to ISO/IEC 6429.

As a consequence the Basic Code Table (table 4) and table 5 showing a version of ISO/IEC 646 with the G0 set of the IRV do not show any specific control characters in columns 0 and 1.

7 1 3

American National Standard

Approval of an American National Standard requires verification by ANSI that the requirements for due process, consensus, and other criteria for approval have been met by the standards developer.

Consensus is established when, in the judgment of the ANSI Board of Standards Review, substantial agreement has been reached by directly and materially affected interests. Substantial agreement means much more than a simple majority, but not necessarily unanimity. Consensus requires that all views and objections be considered, and that a concerted effort be made toward their resolution.

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ANSI/ISO 8859-1-1987

American National Standard for Information Processing –

8-Bit Single-Byte Coded Graphic Character Sets – Part 1: Latin Alphabet No.1

Secretariat

Computer and Business Equipment Manufacturers Association

Approved September 22, 1992
American National Standards Institute, Inc.

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Foreword (This foreword is not part of American National Standard ANSI/ISO 8859-1-1987. This document is identical to ISO 8859-1-1987 and the following four paragraphs are the original foreword as it appeared in that document.)

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work.

Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council. They are approved in accordance with ISO procedures requiring at least 75% approval by the member bodies voting.

International Standard ISO 8859-1 was prepared by Technical Committee ISO/TC 97, *Information processing systems.*

Users should note that all International Standards undergo revision from to time and that any reference made herein to any other International Standard implies its latest edition, unless otherwise stated.

This document contains two annexes. Annexes A and B are informative and are not considered part of this standard.

Requests for interpretation, suggestions for improvement or addenda, or defect reports are welcome. They should be sent to the X3 Secretariat, Computer and Business Equipment Manufacturers Association, 1250 Eye Street, NW, Suite 200, Washington, DC 20005.

This standard was processed and approved for submittal to ANSI by Accredited Standards Committee on Information Processing Systems, X3. Committee approval of the standard does not necessarily imply that all committee members voted for its approval. At the time it approved this standard, the X3 Committee had the following members:

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AMERICAN NATIONAL STANDARD **ANSI/ISO 8859-1-1987**

American National Standard for Information Processing –

8-Bit Single-Byte Coded Graphic Character Sets – Part 1: Latin Alphabet No. 1

0 Introduction

ISO 8859 consists of several parts. Each part specifies a set of up to 191 graphic characters and the coded representation of each of these characters by means of a single 8-bit byte. The use of control functions for the coded representation of composite characters is prohibited by ISO 8859. Each set is intended for use for a group of languages.

ISO 8859/2 specifies a set of 191 graphic characters identified as Latin alphabet No. 2.

1 Scope

This part of ISO 8859 specifies a set of 191 graphic characters identified as Latin alphabet No. 1.

2 Field of application

This set of graphic characters, the Latin alphabet No. 1, is intended for use in data processing and text applications and may also be used for information interchange.

The set contains graphic characters used for general purpose applications in typical office environments in at least the following languages:

Danish, Dutch, English, Faeroese, Finnish, French, German, Icelandic, Irish, Italian, Norwegian, Portuguese, Spanish and Swedish.

This set of graphic characters is suitable for use in a version of an 8-bit code according to ISO 2022 or ISO 4873.

NOTE – ISO 8859 is not intended for use with CCITT-defined Telematic services. If information coded according to ISO 8859 is to be transferred to such services, it will have to conform at the coding interface to their requirements.

3 Conformance

A set of graphic characters is in conformance with this part of ISO 8859 if it comprises all graphic characters specified herein to the exclusion of any other and if their coded representations are those specified by this part of ISO 8859.

Equipment claimed to implement this part of ISO 8859 shall implement all 191 characters.

4 References

ISO 646, *Information processing — ISO 7-bit coded character set for information interchange.*

ISO 2022, *Information processing — ISO 7-bit and 8-bit coded character sets — Code extension techniques.*

ISO 4873, *Information processing — ISO 8-bit code for information interchange — Structure and rules for implementation.*

ISO 6429, *Information processing — ISO 7-bit and 8-bit coded character sets — Additional control functions for character-imaging devices.*

ISO 6937/2, *Information processing — Coded character sets for text communication — Part 2: Latin alphabetic and non-alphabetic graphic characters.*

5 Definitons

For the purpose of this part of ISO 8859 the following definitions apply.

5.1 bit combination; byte: An ordered set of bits that represents a character or is used as a part of the representation of a character.

5.2 character: A member of a set of elements used for the organization, control or representation of data.

5.3 coded character set; code: A set of unambiguous rules that establishes a character set and the one-to-one relationship between each character of the set and its coded representation.

5.4 code table: A table showing the character allocated to each bit combination in a code.

5.5 graphic character: A character, other than a control function, that has a visual representation normally handwritten, printed or displayed, and that has a coded representation consisting of one or more bit combinations.

NOTE – In ISO 8859 a single bit combination is used to represent each character.

5.6 graphic symbol: A visual representation of a graphic character.

5.7 position: That part of a code table identified by its column and row coordinates.

6 Notation, code table and names

6.1 Notation

The bits of the bit combinations of the 8-bit code are identified by b_8, b_7, b_6, b_5, b_4, b_3, b_2 and b_1, where b_8 is the highest-order, or most-significant bit and b_1 is the lowest-order, or least-significant bit.

The bit combinations may be interpreted to represent numbers in binary notation by attributing the following weights to the individual bits:

Bit	b_8	b_7	b_6	b_5	b_4	b_3	b_2	b_1
Weight	128	64	32	16	8	4	2	1

Using these weights, the bit combinations of the 8-bit code represent numbers in the range 0 to 255.

In this part of ISO 8859, the bit combinations are identified by notations of the form xx/yy, where xx and yy are numbers in the range 00 to 15. The correspondence between the notations of the form xx/yy and the bit combinations consisting of the bits b_8 to b_1 is as follows:

- xx is the number represented by b_8, b_7, b_6 and b_5 where these bits are given the weights 8, 4, 2 and 1 respectively;
- yy is the number represented by b_4, b_3, b_2 and b_1 where these bits are given the weights 8, 4, 2 and 1 respectively.

6.2 Layout of the code table

An 8-bit code table consists of 256 positions arranged in 16 columns and 16 rows. The columns and the rows are numbered 00 to 15.

The code table positions are identified by notations of the form xx/yy, where xx is the column number and yy is the row number.

The positions of the code table are in one-to-one correspondence with the bit combinations of the code. The notation of a code table position, of the form xx/yy, is the same as that of the corresponding bit combination.

6.3 Names and meanings

This part of ISO 8859 assigns at least one name to each character. In addition, it specifies a graphic symbol for each graphic character. By convention only capital letters, the graphic symbols of small letters and hyphens are used for writing the names of the characters.

The names chosen to denote graphic characters are intended to reflect their customary meaning. However, except for SPACE (SP), NO-BREAK SPACE (NBSP) and SOFT HYPHEN (SHY), this part of ISO 8859 does not define and does not restrict the meanings of graphic characters. Neither does it specify a particular style or font design for imaging graphic characters.

6.3.1 SPACE (SP)

This character may be interpreted as a graphic character, a control character or as both. As a graphic character it has the visual representation consisting of the absence of a graphic symbol.

6.3.2 NO-BREAK SPACE (NBSP)

A graphic character the visual representation of which consists of the absence of a graphic symbol, for use when a line break is to be prevented in the text as presented.

6.3.3 SOFT HYPHEN (SHY)

A graphic character that is imaged by a graphic symbol identical with, or similar to, that representing HYPHEN, for use when a line break has been established within a word.

7 Specification of the coded character set

This part of ISO 8859 specifies 191 characters allocated to the bit combinations of the code table (table 2). None of these characters are "non-spacing".

The use of control functions, such as BACKSPACE or CARRIAGE RETURN for the coded representation of composite characters is prohibited by ISO 8859.

7.1 Characters of the set and their coded representation

Table 1 — Character set — Coded representation

Bit combination	Name
02/00	SPACE (see 6.3)
02/01	EXCLAMATION MARK
02/02	QUOTATION MARK
02/03	NUMBER SIGN
02/04	DOLLAR SIGN
02/05	PERCENT SIGN
02/06	AMPERSAND
02/07	APOSTROPHE
02/08	LEFT PARENTHESIS
02/09	RIGHT PARENTHESIS
02/10	ASTERISK
02/11	PLUS SIGN
02/12	COMMA
02/13	HYPHEN, MINUS SIGN
02/14	FULL STOP
02/15	SOLIDUS
03/00	DIGIT ZERO
03/01	DIGIT ONE
03/02	DIGIT TWO
03/03	DIGIT THREE
03/04	DIGIT FOUR
03/05	DIGIT FIVE
03/06	DIGIT SIX
03/07	DIGIT SEVEN
03/08	DIGIT EIGHT
03/09	DIGIT NINE
03/10	COLON
03/11	SEMICOLON
03/12	LESS-THAN SIGN
03/13	EQUALS SIGN
03/14	GREATER-THAN SIGN
03/15	QUESTION MARK
04/00	COMMERCIAL AT
04/01	CAPITAL LETTER A
04/02	CAPITAL LETTER B
04/03	CAPITAL LETTER C
04/04	CAPITAL LETTER D
04/05	CAPITAL LETTER E
04/06	CAPITAL LETTER F
04/07	CAPITAL LETTER G
04/08	CAPITAL LETTER H
04/09	CAPITAL LETTER I
04/10	CAPITAL LETTER J
04/11	CAPITAL LETTER K
04/12	CAPITAL LETTER L
04/13	CAPITAL LETTER M
04/14	CAPITAL LETTER N
04/15	CAPITAL LETTER O
05/00	CAPITAL LETTER P
05/01	CAPITAL LETTER Q
05/02	CAPITAL LETTER R
05/03	CAPITAL LETTER S
05/04	CAPITAL LETTER T
05/05	CAPITAL LETTER U
05/06	CAPITAL LETTER V
05/07	CAPITAL LETTER W
05/08	CAPITAL LETTER X
05/09	CAPITAL LETTER Y
05/10	CAPITAL LETTER Z
05/11	LEFT SQUARE BRACKET
05/12	REVERSE SOLIDUS
05/13	RIGHT SQUARE BRACKET
05/14	CIRCUMFLEX ACCENT
05/15	LOW LINE
06/00	GRAVE ACCENT
06/01	SMALL LETTER a
06/02	SMALL LETTER b
06/03	SMALL LETTER c
06/04	SMALL LETTER d
06/05	SMALL LETTER e
06/06	SMALL LETTER f
06/07	SMALL LETTER g
06/08	SMALL LETTER h
06/09	SMALL LETTER i
06/10	SMALL LETTER j
06/11	SMALL LETTER k
06/12	SMALL LETTER l
06/13	SMALL LETTER m
06/14	SMALL LETTER n
06/15	SMALL LETTER o
07/00	SMALL LETTER p
07/01	SMALL LETTER q
07/02	SMALL LETTER r
07/03	SMALL LETTER s
07/04	SMALL LETTER t
07/05	SMALL LETTER u
07/06	SMALL LETTER v
07/07	SMALL LETTER w
07/08	SMALL LETTER x
07/09	SMALL LETTER y
07/10	SMALL LETTER z
07/11	LEFT CURLY BRACKET
07/12	VERTICAL LINE
07/13	RIGHT CURLY BRACKET
07/14	TILDE
10/00	NO-BREAK SPACE (see 6.3)
10/01	INVERTED EXCLAMATION MARK
10/02	CENT SIGN
10/03	POUND SIGN
10/04	CURRENCY SIGN
10/05	YEN SIGN
10/06	BROKEN BAR
10/07	PARAGRAPH SIGN, SECTION SIGN
10/08	DIAERESIS
10/09	COPYRIGHT SIGN
10/10	FEMININE ORDINAL INDICATOR
10/11	LEFT ANGLE QUOTATION MARK
10/12	NOT SIGN
10/13	SOFT HYPHEN (see 6.3)
10/14	REGISTERED TRADE MARK SIGN
10/15	MACRON
11/00	RING ABOVE, DEGREE SIGN
11/01	PLUS-MINUS SIGN
11/02	SUPERSCRIPT TWO
11/03	SUPERSCRIPT THREE
11/04	ACUTE ACCENT
11/05	MICRO SIGN
11/06	PILCROW SIGN
11/07	MIDDLE DOT
11/08	CEDILLA
11/09	SUPERSCRIPT ONE
11/10	MASCULINE ORDINAL INDICATOR
11/11	RIGHT ANGLE QUOTATION MARK
11/12	VULGAR FRACTION ONE QUARTER
11/13	VULGAR FRACTION ONE HALF
11/14	VULGAR FRACTION THREE QUARTERS
11/15	INVERTED QUESTION MARK
12/00	CAPITAL LETTER A WITH GRAVE ACCENT

Table 1 – *(concluded)*

Bit combination	Name
12/01	CAPITAL LETTER A WITH ACUTE ACCENT
12/02	CAPITAL LETTER A WITH CIRCUMFLEX ACCENT
12/03	CAPITAL LETTER A WITH TILDE
12/04	CAPITAL LETTER A WITH DIAERESIS
12/05	CAPITAL LETTER A WITH RING ABOVE
12/06	CAPITAL DIPHTHONG A WITH E
12/07	CAPITAL LETTER C WITH CEDILLA
12/08	CAPITAL LETTER E WITH GRAVE ACCENT
12/09	CAPITAL LETTER E WITH ACUTE ACCENT
12/10	CAPITAL LETTER E WITH CIRCUMFLEX ACCENT
12/11	CAPITAL LETTER E WITH DIAERESIS
12/12	CAPITAL LETTER I WITH GRAVE ACCENT
12/13	CAPITAL LETTER I WITH ACUTE ACCENT
12/14	CAPITAL LETTER I WITH CIRCUMFLEX ACCENT
12/15	CAPITAL LETTER I WITH DIAERESIS
13/00	CAPITAL ICELANDIC LETTER ETH
13/01	CAPITAL LETTER N WITH TILDE
13/02	CAPITAL LETTER O WITH GRAVE ACCENT
13/03	CAPITAL LETTER O WITH ACUTE ACCENT
13/04	CAPITAL LETTER O WITH CIRCUMFLEX ACCENT
13/05	CAPITAL LETTER O WITH TILDE
13/06	CAPITAL LETTER O WITH DIAERESIS
13/07	MULTIPLICATION SIGN
13/08	CAPITAL LETTER O WITH OBLIQUE STROKE
13/09	CAPITAL LETTER U WITH GRAVE ACCENT
13/10	CAPITAL LETTER U WITH ACUTE ACCENT
13/11	CAPITAL LETTER U WITH CIRCUMFLEX ACCENT
13/12	CAPITAL LETTER U WITH DIAERESIS
13/13	CAPITAL LETTER Y WITH ACUTE ACCENT
13/14	CAPITAL ICELANDIC LETTER THORN
13/15	SMALL GERMAN LETTER SHARP s
14/00	SMALL LETTER a WITH GRAVE ACCENT
14/01	SMALL LETTER a WITH ACUTE ACCENT
14/02	SMALL LETTER a WITH CIRCUMFLEX ACCENT
14/03	SMALL LETTER a WITH TILDE
14/04	SMALL LETTER a WITH DIAERESIS
14/05	SMALL LETTER a WITH RING ABOVE
14/06	SMALL DIPHTHONG a WITH e
14/07	SMALL LETTER c WITH CEDILLA
14/08	SMALL LETTER e WITH GRAVE ACCENT
14/09	SMALL LETTER e WITH ACUTE ACCENT
14/10	SMALL LETTER e WITH CIRCUMFLEX ACCENT
14/11	SMALL LETTER e WITH DIAERESIS
14/12	SMALL LETTER i WITH GRAVE ACCENT
14/13	SMALL LETTER i WITH ACUTE ACCENT
14/14	SMALL LETTER i WITH CIRCUMFLEX ACCENT
14/15	SMALL LETTER i WITH DIAERESIS
15/00	SMALL ICELANDIC LETTER ETH
15/01	SMALL LETTER n WITH TILDE
15/02	SMALL LETTER o WITH GRAVE ACCENT
15/03	SMALL LETTER o WITH ACUTE ACCENT
15/04	SMALL LETTER o WITH CIRCUMFLEX ACCENT
15/05	SMALL LETTER o WITH TILDE
15/06	SMALL LETTER o WITH DIAERESIS
15/07	DIVISION SIGN
15/08	SMALL LETTER o WITH OBLIQUE STROKE
15/09	SMALL LETTER u WITH GRAVE ACCENT
15/10	SMALL LETTER u WITH ACUTE ACCENT
15/11	SMALL LETTER u WITH CIRCUMFLEX ACCENT
15/12	SMALL LETTER u WITH DIAERESIS
15/13	SMALL LETTER y WITH ACUTE ACCENT
15/14	SMALL ICELANDIC LETTER THORN
15/15	SMALL LETTER y WITH DIAERESIS

7.2 Code table

The code table (table 2) shows the characters listed at the position in the code table corresponding to the specified bit combination.

The shaded positions correspond to bit combinations that do not represent graphic characters. Their use is outside the scope of ISO 8859; it is specified in other International Standards, for example ISO 646 or ISO 6429.

8 Designation of the character set

The graphic characters of this part of ISO 8859 constitute a single coded character set. However, when this character set is implemented together with other coding standards such as ISO 2022 or ISO 4873, the code table of this part of ISO 8859 shall be considered to consist of the following components:

- The character SPACE represented by bit combination 02/00.
- A 94-character G0 graphic character set represented by bit combinations 02/01 to 07/14.
- A 96-character G1 graphic character set represented by bit combinations 10/00 to 15/15.

When required by other coding standards, for example ISO 2022 or ISO 4873, the following pair of escape sequences shall be used:

ESC 02/08 04/02
ESC 02/13 04/01

to designate the G0 and the G1 sets, respectively. According to ISO 2022, the character SPACE does not require designation.

Table 2 – Code table

				b_8	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
				b_7	0	0	0	0	1	1	1	1	0	0	0	0	1	1	1	1
				b_6	0	0	1	1	0	0	1	1	0	0	1	1	0	0	1	1
				b_5	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1
b_4	b_3	b_2	b_1		00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15
0	0	0	0	00			SP	0	@	P	`	p			NBSP	°	À	Ð	à	ð
0	0	0	1	01			!	1	A	Q	a	q			¡	±	Á	Ñ	á	ñ
0	0	1	0	02			"	2	B	R	b	r			¢	²	Â	Ò	â	ò
0	0	1	1	03			#	3	C	S	c	s			£	³	Ã	Ó	ã	ó
0	1	0	0	04			$	4	D	T	d	t			¤	´	Ä	Ô	ä	ô
0	1	0	1	05			%	5	E	U	e	u			¥	µ	Å	Õ	å	õ
0	1	1	0	06			&	6	F	V	f	v			¦	¶	Æ	Ö	æ	ö
0	1	1	1	07			'	7	G	W	g	w			§	·	Ç	×	ç	÷
1	0	0	0	08			(	8	H	X	h	x			¨	¸	È	Ø	è	ø
1	0	0	1	09			)	9	I	Y	i	y			©	¹	É	Ù	é	ù
1	0	1	0	10			*	:	J	Z	j	z			ª	º	Ê	Ú	ê	ú
1	0	1	1	11			+	;	K	[	k	{			«	»	Ë	Û	ë	û
1	1	0	0	12			,	<	L	\	l	|			¬	¼	Ì	Ü	ì	ü
1	1	0	1	13			-	=	M	]	m	}			SHY	½	Í	Ý	í	ý
1	1	1	0	14			.	>	N	^	n	~			®	¾	Î	Þ	î	þ
1	1	1	1	15			/	?	O	_	o				¯	¿	Ï	ß	ï	ÿ

Annex A

Geographical areas of application of the coded character set of this part of ISO 8859

(This annex does not form part of the standard.)

The coded character set of this part of ISO 8859 contains graphic characters used in at least the following countries:

Argentina
Australia
Austria
Belgium
Belize
Bolivia
Brazil
Canada
Chile
Colombia
Costa Rica
Cuba
Denmark
Ecuador
Faroe Islands
Finland
France
Germany
Guatemala
Guyana
Honduras
Iceland
Ireland
Italy
Liechtenstein
Luxemburg
Mexico
New Zealand
Nicaragua
Norway
Panama
Paraguay
Peru
Portugal
El Salvador
Spain
Surinam
Sweden
Switzerland
The Netherlands
United Kingdom
United States
Uruguay
Venezuela

Annex B

Relationship between this part of ISO 8859 and ISO 6937/2

(This annex does not form part of the standard.)

The character set defined in this part of ISO 8859 consists of SPACE, 186 characters that form a sub-set of the repertoire of graphic characters of ISO 6937/2 and the following four characters that are not defined in the 1983 edition of ISO 6937/2:

¦	BROKEN BAR
—	NOT SIGN
NBSP	NO-BREAK SPACE
SHY	SOFT HYPHEN

It is the intention to include these four characters in ISO 6937/2, in order that its character repertoire be a super-set of that of this 8-bit single byte coded graphic character set.

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SECTION 1

START-STOP TERMINALS

Recommendation S.1

INTERNATIONAL TELEGRAPH ALPHABET No. 2

(Malaga-Torremolinos, 1984; amended Melbourne, 1988)

1 Introduction

1.1 This Recommendation defines the repertoire of the graphic and control characters used in International Telegraph Alphabet No. 2 (ITA2) and the coded representation of these characters for communication purposes. It also contains provisions concerning the use of certain specific combinations.

1.2 The coded character set of ITA2 is based on a 5-unit-structure.

1.3 ITA2 is also defined in Recommendation F.1 for the international public telegram service, and it is specified in Recommendation F.60 that it should also be used for the telex service. It may also be used for other applications, such as specialized or leased circuits.

1.4 For definitions concerning alphabetic telegraphy, see definitions in Recommendation R.140 and the International Electrotechnical Vocabulary (IEV), Chapter 721.

2 Character repertoire

2.1 Graphic characters that have a corresponding signal in ITA 2 are:

- the 26 latin alphabetic characters: A B C D E F G H I J K L M N O P Q R S T U V W X Y Z;
- decimal figures: 0 1 2 3 4 5 6 7 8 9;
- punctuation marks and miscellaneous signs:

Full Stop	.
Comma	,
Colon or division sign	:
Question mark	?
Apostrophe	'
Cross or addition sign	+
Hyphen or dash or subtraction sign	–
Fraction bar or division sign	/
Equal sign or double hyphen	=
Left-hand bracket (parenthesis)	(
Right-hand bracket (parenthesis)	)

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2.2 Three graphic characters (such as accented letters and currency signs) may be applied for national or private use (see § 4.2)

2.3 This Recommendation does not define the particular printing style, font or case (capital or small letters) of graphic characters, nor does it define the layout of keyboards in teleprinters or similar terminal devices.

2.4 The control characters provided in ITA2 are:

- "Who are you?" (operation of the answerback unit of the corresponding installation)
- operation of an audible signal of the corresponding installation;
- carriage return;
- line-feed;
- letter-shift;
- figure-shift;
- space or blank;
- all-space or null (no tape perforation).

3 Coding

3.1 The 32 combinations available in ITA2 are produced by a sequence of five units, each of which may assume one of two significant conditions (A or Z), as shown in Table 1/S.1.

3.2 Condition A corresponds to start polarity, no perforation in paper tape and symbol 0 of the binary notation. Condition Z corresponds to stop polarity, perforation in paper tape and symbol 1 in the binary notation.

For the equivalent frequency and amplitude modulation corresponding to conditions A and Z in voice-frequency telegraph equipment, see Recommendation V.1 and the relevant Series R Recommendations.

Note 1 – The level and polarity of voltage and current corresponding to conditions A and Z (e.g. in the local end with its termination) are national options and hence are not defined internationally.

Note 2 – The terms "start" and "stop", "space" and "mark" have also been used to describe conditions A and Z respectively (see definition 31.37 in Recommendation R.140).

4 Particular combinations

4.1 In accordance with Recommendation S.8 and the Series U Recommendations, "WRU" (who are you? combination No. 4 in figure case), is used to operate the answerback unit of the corresponding instrument in the international telex and gentex services, and may also provide a printed symbol (as in Table 2/S.1).

4.2 Since some Administrations assign combination Nos. 6, 7 and 8 in figure case for internal use whereas others do not, it is desirable to avoid varying interpretation in these circumstances that might result if they were used freely in international services. Consequently the use of combination Nos. 6, 7 and 8 in figure case is not defined and therefore should not be used in international services, except by direct agreement between Administrations; and it is recommended:

- that, in all services, they should be shown in some special manner on the keyboards and:
- that services in which they are not used should place on the secondary position on the printing blocks (or on the equivalent mechanism) an arbitrary sign, for the letters F, G and H such as, for instance, a square. The appearance of such sign on the paper is to indicate an abnormal impression.

4.3 Combination No. 10 "audible signal", may also provide a printed symbol (as in Table 2/S.1)

4.4 Combinations Nos. 29 and 30, "letter-shift" and "figure-shift", respectively, are used to place the terminal installation in the "letter" or "figure" position, so that:

- any combination No. 1 to 26 received engenders a printed signal in the "letter" case (second column of Table 1/S.1) if the last shift signal received is a "letter-shift" signal;
- any combination No. 1 to 26 received engenders a printed signal in the "figure" case (third column of Table 1/S.1) if the last shift signal received is a "figure-shift" signal", except as noted for combinations Nos. 4 and 10 in §§ 4.1 and 4.3.

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TABLE 1/S.1

International Telegraph Alphabet No. 2 (ITA2)

Combination number	Letter case	Figure case	Coding				
			1	2	3	4	5
1	A	–	Z	Z	A	A	A
2	B	?	Z	A	A	Z	Z
3	C	:	A	Z	Z	Z	A
4	D	See § 4.1	Z	A	A	Z	A
5	E	3	Z	A	A	A	A
6	F	See § 4.2	Z	A	Z	Z	A
7	G		A	Z	A	Z	Z
8	H		A	A	Z	A	Z
9	I	8	A	Z	Z	A	A
10	J	Audible Signal	Z	Z	A	Z	A
11	K	(	Z	Z	Z	Z	A
12	L	)	A	Z	A	A	Z
13	M	.	A	A	Z	Z	Z
14	N	,	A	A	Z	Z	A
15	O	9	A	A	A	Z	Z
16	P	0	A	Z	Z	A	Z
17	Q	1	Z	Z	Z	A	Z
18	R	4	A	Z	A	Z	A
19	S	'	Z	A	Z	A	A
20	T	5	A	A	A	A	Z
21	U	7	Z	Z	Z	A	A
22	V	=	A	Z	Z	Z	Z
23	W	2	Z	Z	A	A	Z
24	X	/	Z	A	Z	Z	Z
25	Y	6	Z	A	Z	A	Z
26	Z	+	Z	A	A	A	Z
27	Carriage-return		A	A	A	Z	A
28	Line-feed		A	Z	A	A	A
29	Letter-shift	See § 4.5	Z	Z	Z	Z	Z
30	Figure-shift		Z	Z	A	Z	Z
31	Space		A	A	Z	A	A
32	See § 4.7		A	A	A	A	A

Note – In serial transmission, code element 1 is transmitted first.

4.5 Combinations Nos. 29 (letter-shift), 30 (figure-shift) and 32 (all-space, null or no tape perforation) shall not affect the spacing movement of terminal machines, except where their reception is indicated by printing a symbol, as mentioned in § 5 below.

4.6 *Use of capital and small letters*

4.6.1 In ITA2, it is possible to use teleprinters with two series of letter characters, capital and small letters.

4.6.2 It is possible to use sequences of the shift combinations of ITA2 for transfer from one series to the other.

4.6.3 If this possibility is used, it is essential to obtain compatibility with teleprinters having only one series of letter characters.

4.7 *Use of combination No. 32*

4.7.1 Combination No. 32 can be used in certain sequences of switching signals; these uses are set out in Recommendations U.11, U.20, U.22 and S.4.

4.7.2 Combination No. 32 must not be used during the phase of communication (after a call is set up) in the international telex service.

4.7.3 Combination No. 32 can be used during the phase of communication after a call is set up in domestic national service or by bilateral agreement between two Administrations, as a command signal for certain functions, e.g. transfer to a national alphabet other than ITA2;

4.7.4 Combination No. 32 must not be used for transfer from one form of characters to another while remaining within ITA2, nor for transfer from one international telegraph alphabet to another.

5 Graphic representation of control characters

Where a graphic indication of the reception or transmission of certain control characters is required, this should be effected by printing the symbols shown in Table 2/S.1.

TABLE 2/S.1

Printed symbols for control characters

Function	Combination No.	Case	Symbol	Alphabetic representation
Who are you? (WRU)	4	Figure	⌧ (see Note 1)	EQ
Audible signal (bell)	10	Figure	⍾	BL
Carriage-return	27	Either	←	CR
Line-feed	28	Either	≡	LF
Letter-shift	29	Either	↓	SL or LS
Figure-shift	30	Either	↑	SF or FS
Space	31	Either	△	SP
All-space: Null	32	Either	□	NU

Note 1 – The pictorial representation shown is a schematic of ✠, which may also be used when equipment allows.

Note 2 – Each alphabetic representation is to be considered as a single symbol. It may occupy one position on a printed or displayed line.

Recommendation S.2

CODING SCHEME USING INTERNATIONAL TELEGRAPH ALPHABET No. 2 (ITA2) TO ALLOW THE TRANSMISSION OF CAPITAL AND SMALL LETTERS

(Melbourne, 1988)

The CCITT,

considering

(a) that CCITT Recommendation S.1, International Telegraph Alphabet No. 2 (ITA2), permits capital or small letter printing;

(b) that there are advantages in establishing an international standard for the transmission of capital and small letters using International Telegraph Alphabet No. 2,

unanimously declares the view

(1) that the ability to transmit and print capital and small letters should be based on an extended use of ITA2;

(2) that figure-shift (FS) and letter-shift (LS) should be the only shift characters used;

(3) that the number of shift characters introduced in the transmitted information should be minimized;

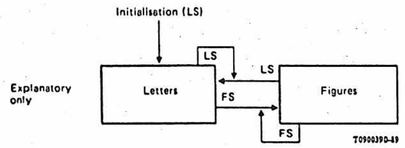
(4) that the operating principles described in this Recommendation should apply.

1 Scope

1.1 Existing terminal equipment making use of ITA2 may not discriminate between capital and small letter printing. The decision to print in all capital or all small letters is a national matter and not affected by the received code combination of ITA2.

1.2 This Recommendation specifies a procedure whereby the terminal equipment may transmit information to allow the receiving terminal to discriminate between capital and small letter printing.

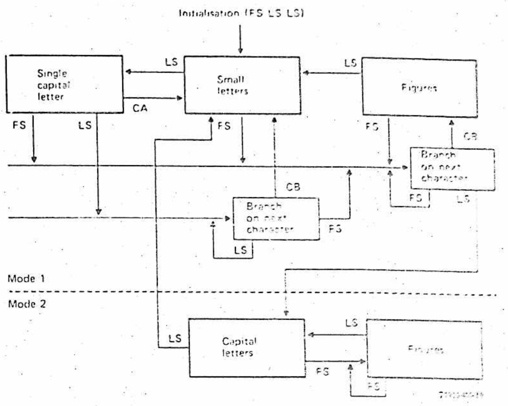
1.3 To assist understanding, Figure 1/S.2 shows diagrammatically the operating procedure of existing terminal equipment; Figure 2/S.2 shows the operating procedure specified in this Recommendation.



Change occurs:
LS On receipt of letter-shift character
FS On receipt of figure-shift character

FIGURE 1/S.2

Operating procedures of existing terminal equipments (ITA2)



Change occurs:
LS On receipt of letter-shift character
FS On receipt of figure-shift character
CA After the processing of non-shift character
CB Before the processing of any non-shift character

FIGURE 2/S.2

Operating procedures of terminal equipments specified in this Recommendation (ITA2)

2 Operating principles

2.1 *Operating modes*

2.1.1 The terminal equipment should operate in the following two modes:

Mode 1 – Transmission/reception of small letters, single capital letters and figures;

Mode 2 – Transmission/reception of capital letters and figures.

The introduction of two modes of operation is to minimize the number of shift-characters transmitted.

2.1.2 At the beginning of any transmission, it may normally be assumed, that the equipment concerned is in Mode 1, small letters. If an initialization sequence is required it should consist of a contiguous sequence of FS, LS, LS characters.

2.2 *Selection within operating modes*

2.2.1 Where the terminal equipment is set to small letters in Mode 1 and a single capital letter is to be transmitted it should be denoted as a capital letter by preceding the character transmission with a single LS character. Two LS characters will be required when the previously transmitted character was a figure. If the next character is a non-shift character then it will be transmitted/printed and the terminal equipment should be reverted to small letter operation. If the next character is a shift character, the terminal equipment should be prepared to branch on the next character.

2.2.2 In Mode 1 a single FS character should change the terminal equipment from small letter to figure transmission/reception.

2.2.3 In Mode 2 a single FS or LS character should change the terminal equipment between figure and capital letter operation respectively.

2.3 *Selection of operating mode*

2.3.1 Where the terminal equipment is set to Mode 1 and a group of three or more capital letters is to be transmitted, ignoring any non-letter characters separating them, then to improve efficiency of transmission, the terminal equipment may be set to Mode 2 (capital letters) and precede subsequent letter character transmission by a contiguous sequence of a single FS and a single LS character.

The receiving terminal equipment on detecting the FS, LS sequence should set the receiving terminal to Mode 2 and print all following received letter characters as capital letters.

2.3.2 Where the terminal is set to Mode 2 and small letter is to be transmitted the termminal equipment should be set to Mode 1 and precede subsequent letter character transmission by a single LS character. Two LS characters will be required where the previously transmitted character was a figure.

The receiving terminal equipment on detecting the one or two LS characters respectively should set the receiving terminal to Mode 1 and print the following received letter character as a small letter.

2.4 *Manual terminal operation*

2.4.1 For manual operation the terminal should be provided with, in addition to the normal shift key, a capital-lock key or a shift-lock key or both.

2.4.2 Where the terminal is set to Mode 1 the condition of the lock key should be examined for the groups of capital letters. If the locked condition is detected the terminal should be set to Mode 2 and the subsequent letter character transmission preceded by the transmission of a contiguous sequence of a single FS and single LS character.

2.4.3 Where the terminal is set to Mode 2 the shift key (single character) and the lock key (groups of characters) should be simultaneously examined. If neither the shift key is operated nor the locked condition is detected, the terminal should be set to Mode 1 and the subsequent letter character transmission should be preceded by a single extra LS character.

2.4.4 A start key to generate the initialization sequence may be provided.

2.5 *Automatic terminal operation*

2.5.1 Where the terminal is set to Mode 1 and the next letter character to be transmitted is a capital letter, the next two letter characters should be examined for capital letters, ignoring any non-letter characters separating them. If all three letter characters are capital letters then the terminal should be set to Mode 2 and subsequent letter character transmission should be preceded by a contiguous sequence of a single FS and a single LS character. If the first letter character to be transmitted is a capital letter but either, or both, of the two subsequent letter characters are not, the first letter character should be transmitted preceded by a single extra LS character.

2.5.2 Where the terminal is set to Mode 2 the next character to be transmitted should be examined and if it is a small letter the terminal should be set to Mode 1.

3 **Transmission of WRU and answerback**

3.1 The coding and transmission of the WRU and answerback signals is not affected by this Recommendation.

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4 **Provision of LS and FS functions**

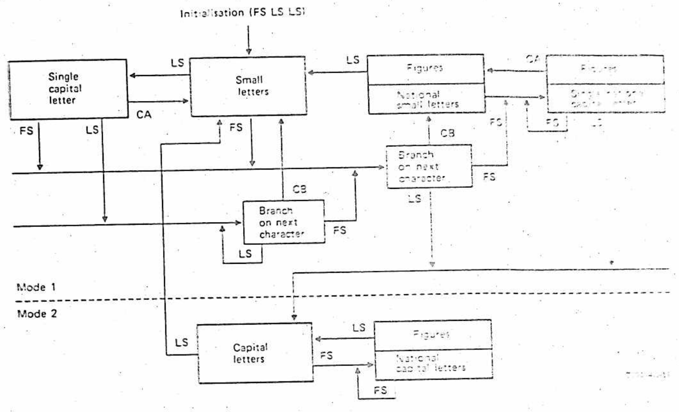
4.1 It should be noted that in some circumstances it may be necessary to generate separate LS and FS characters for national applications.

5 **National versions**

5.1 The use of ITA2 combination No. 32, either in an escape sequence or as a single character, to enter a national alphabet is not affected by this Recommendation.

5.2 It is possible to apply the principles described in this Recommendation to small and capital letter transmission/printing of a national alphabet.

5.3 Figure 3/S.2 of this Recommendation gives some guidance to Administrations, who may wish to include national capital and small letters.



Change occurs:
LS On receipt of letter-shift character
FS On receipt of figure-shift character
CA After the processing of non-shift character
CB Before the processing of any non-shift character

FIGURE 3/S.2

Operating procedures of terminal equipments specified in this Recommendation (ITA2) (national version)

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Recommendation S.18

CONVERSION BETWEEN INTERNATIONAL TELEGRAPH ALPHABET No. 2 AND INTERNATIONAL ALPHABET No. 5

(Geneva, 1980)

The CCITT,

considering

(a) that the Recommendation cited in [1] defines International Telegraph Alphabet No. 2 (ITA2), which is used, for example, in the international telex service;

(b) that International Alphabet No. 5 (IA5), defined in Recommendation T.50 [2], has been established jointly by the CCITT and the International Organization for Standardization (ISO) for use in data transmission (for example);

(c) that rules for converting from ITA2 to IA5 and vice versa are desirable to facilitate interworking, for example between terminals in the international telex service and terminals in data networks;

(d) that a suitable set of rules has been drawn up in collaboration with ISO;

(e) that for specific user applications some variations in the tables below may be developed and applied by bilateral agreement;

(f) that this Recommendation does not define whether the alphabetic characters of ITA2 are represented as capital or small letters;

unanimously recommends

that the following rules for conversion should apply.

1 Conversion from ITA2 to IA5

1.1 The conversion of characters shall be as specified in Table 1/S.18.

1.2 Annex A, together with Table A-1/S.18, provides information on alternative conversions that are in general use in some countries.

2 Conversion from IA5 to ITA2

2.1 The conversion of characters shall be as specified in Table 2/S.18.

2.2 The control characters of positions 0/1, 0/2, 0/3, 0/4, 0/6, 1/0, 1/5, 1/6 and 1/7 are generally not converted because they are removed from the character string by the link control equipment.

2.3 Characters for which there are no direct equivalents shall be represented by the single character question mark (?), unless prior agreement has been made between the interchange parties.

2.4 The greater number of code combinations available in IA5 means that not every character can be translated unambiguously into a single ITA2 character. Use of a single character, rather than a multi-character representation, will minimize formatting problems.

2.5 Annex A together with Table A-2/S.18 provide information on some alternative conversions that are in use in some countries.

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TABLE 1/S.18

Conversion from ITA2 to IA5

ITA2 combination number	ITA2 letter case	IA5 Character (See Note 3)	IA5 Coding	IA5 Character (See Note 3)	IA5 Coding	ITA2 figure case	IA5 Character	IA5 Coding
1	A	A	4/1	a	6/1	–	–	2/13
2	B	B	4/2	b	6/2	?	?	3/15
3	C	C	4/3	c	6/3	:	:	3/10
4	D	D	4/4	d	6/4	WRU	ENQ (See Note 1)	0/5
5	E	E	4/5	e	6/5	3	3	3/3
6	F	F	4/6	f	6/6	National use	(See Note 4)	
7	G	G	4/7	g	6/7	National use		
8	H	H	4/8	h	6/8	National use		
9	I	I	4/9	i	6/9	8	8	3/8
10	J	J	4/10	j	6/10	BELL	BEL	0/7
11	K	K	4/11	k	6/11	(	(	2/8
12	L	L	4/12	l	6/12	)	)	2/9
13	M	M	4/13	m	6/13	.	.	2/14
14	N	N	4/14	n	6/14	,	,	2/12
15	O	O	4/15	o	6/15	9	9	3/9
16	P	P	5/0	p	7/0	0	0	3/0
17	Q	Q	5/1	q	7/1	1	1	3/1
18	R	R	5/2	r	7/2	4	4	3/4
19	S	S	5/3	s	7/3	'	'	2/7
20	T	T	5/4	t	7/4	5	5	3/5
21	U	U	5/5	u	7/5	7	7	3/7
22	V	V	5/6	v	7/6	=	=	3/13
23	W	W	5/7	w	7/7	2	2	3/2
24	X	X	5/8	x	7/8	/	/	2/15
25	Y	Y	5/9	y	7/9	6	6	3/6
26	Z	Z	5/10	z	7/10	+	+	2/11

ITA2 combination number	ITA2 character (either case)	IA5 character	IA5 coding
27	Carriage-return	FE_5	0/13
28	Line-feed	FE_2	0/10
29	Letter-shift	(See Note 2)	
30	Figure-shift	(See Note 2)	
31	Space	SP	2/0
32	Not normally used	(See Note 4)	[illegible]

Note 1 – This character is used only to operate the answer-back unit of the corresponding instrument in the international public services.

Note 2 – These characters have no corresponding function in IA5. Conversion equipment operates the appropriate shift and discards the characters.

Note 3 – Small or capital letters may be used, however intermixing of small and capital letters is not allowed.

Note 4 – These characters have no international allocation.

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TABLE 2/S.18

Conversion from IA5 to ITA2

	0	1	2	3	4	5	6	7
0	NUL ?	DLE ?	SP SP	0 0	@ ?	P P	` ?	p P
1	SOH ?	DC$_1$?	! ?	1 1	A A	Q Q	a A	q Q
2	STX ?	DC$_2$?	" ?	2 2	B B	R R	b B	r R
3	ETX ?	DC$_3$?	# ?	3 3	C C	S S	c C	s S
4	EOT ?	DC$_4$?	¤ ?	4 4	D D	T T	d D	t T
5	ENQ WRU	NAK ?	% ?	5 5	E E	U U	e E	u U
6	ACK ?	SYN ?	& ?	6 6	F F	V V	f F	v V
7	BEL BEL	ETB ?	' '	7 7	G G	W W	g G	w W
8	FE$_0$?	CAN ?	((	8 8	H H	X X	h H	x X
9	FE$_1$?	EM ?	))	9 9	I I	Y Y	i I	y Y
10	FE$_2$ LF	SUB ?	* ?	: :	J J	Z Z	j J	z Z
11	FE$_3$?	ESC ?	+ +	; ?	K K	[?	k K	{ ?
12	FE$_4$?	IS$_4$?	, ,	< ?	L L	\ ?	l L	| ?
13	FE$_5$ CR	IS$_3$?	– –	= =	M M	] ?	m M	} ?
14	SO ?	IS$_2$?	. .	> ?	N N	^ ?	n N	‾ ?
15	SI ?	IS$_1$?	/ /	? ?	O O	_ ?	o O	DEL removed

IA5 / ITA2

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Note – Characters allocated to letter case or figure case are specified in Table 1/S.18. The current converted character must be preceded by the appropriate shift character if a change of case is required, i.e. if the last shift that occurred differs from the required one.

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ANNEX A

(to Recommendation S.18)

Alternative conversions between IA5 and ITA2

A.1 Recommendation S.18 permits alternative conversions for characters that have no direct equivalents, provided these conversions are agreed between interchange parties. Other alternatives may be used.

A.2 Tables A-1/S.18 and A-2/S.18 list conversions that are in use in some countries.

A.3 In some nationally adapted applications of ITA2 and IA5, special conversion rules are required because national characters have been allocated in different orders in the coded character sets concerned.

A.4 NUL is equivalent to *all space* (combination No. 32 or NU) in ITA2.

TABLE A-1/S.18

Examples of alternative conversions from ITA2 to IA5

ITA2				IA5		
Alternative	Case	Combination No.	Character	Character	Code	Remarks
a)	Figure Figure Figure	6 7 8	National use	SUB SUB SUB	[illegible]	
b)	Figure Figure Figure	6 7 8	National use		[illegible]	See A.3
c)	Figure Figure Figure	6 7 8	National use		[illegible]	See A.3
d)	Either Either	29 30	Letter shift Figure shift	IS$_2$ IS[illegible]	[illegible]	
e)	Either Either	29 30	Letter shift Figure shift	DEL DEL	[illegible]	
f)	As e) but with additional agreement that only shift characters following the first one are converted to [illegible]. The first one is treated according to Table 1/S 18.					
g)	Either	32	NU	NUL	[illegible]	See A.4

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TABLE A-2/S.18

Examples of alternative conversions from IA5 to ITA2

IA5		ITA2		Remarks
Code	Character	Characters	Combinations	
0/0	NUL	NU	32	See §A.4
0/1 0/2 0/3 0/4 0/6 1/1 1/5 1/6 1/7	SOH STX ETX EOT ACK DLE NAK SYN ETB	)?)	12 (right parenthesis) 2 (question mark) 12 (right parenthesis) in figure case	Alternative conversions where characters not removed from the character string by the link control equipment or by convention
0/8 0/9 0/11 0/12 0/14 0/15 1/1 1/2 1/3 1/4 1/8 1/9 1/10 1/11 1/12 1/13	FE_0 FE_1 FE_3 FE_4 SO SI DC_1 DC_2 DC_3 DC_4 CAN EM SUB ESC IS_4 IS_3	)?)	12 (right parenthesis) 2 (question mark) 12 (right parenthesis) in figure case	
1/14 1/15	IS_2 IS_1	Letter-shift Figure-shift	29 30	See also Table A-1/S.18. Combinations 29 and 30 may be used with either case

2/1
2/2
2/3
2/4
2/5
2/6
2/10
3/11
3/12
3/14
4/0
5/14
5/15
6/0
7/11
7/12
7/13
7/14
	!
	"
	#
	¤
	%
	&
	*
	;
	<
	>
	@
	^
	_
	`
	{
	|
	}
	‾
		(?)	11 (left parenthesis)
			2 (question mark)
			12 (right parenthesis)
			in figure case	

5/11 5/12 5/13	[\\ ]	National use options	6 7 8 in figure case	See §A.3

7/11
7/12
7/13
	{
	|
	}
		National use options	6
			7
			8 in figure case
				See §A.3

7/15	DEL	Letter-shift	29	

Note – Use of *new line* requires additional agreement between the interchange parties.

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References

[1] CCITT Recommendation *Operational provisions for the international public telegram service*, Rec. F.1, § C.

[2] CCITT Recommendation *International Alphabet No. 5*, Rec. T.50.

Recommendation S.19

CALLING AND ANSWERING IN THE TELEX NETWORK WITH AUTOMATIC TERMINAL EQUIPMENT

(Geneva, 1980)

1 General

1.1 This Recommendation describes a method of originating and answering calls on the 50-baud telex network by means of an automatic terminal using a simple telegraph-type interface for the exchange of data or messages.

1.2 The equipment that processes these data or messages at the terminal is referred to as the data terminal equipment (DTE). It should be able to carry out automatically all the operations required to set up and clear down calls as well as the sending and receiving of information at 50 bauds on the telex network.

1.3 The data circuit terminating equipment (DCE) constitutes the frontier between the DTE and the telex network and offers the possibility of remote maintenance. The DCE effects all signal conversions between the DTE and the telex subscriber line. The DCE may be either a separate unit or a built-in component of the DTE.

2 DCE/DTE interface

2.1 The interchange circuits used for the interface (if any) between the DCE and the DTE are defined in Recommendation V.24 [1] and comply with the technical specifications in either Recommendation V.28 [2] or Recommendation V.10 [3]. Thus the correspondence between the voltages and the significant states is as shown in Table 1/S.16.

2.2 The DCE/DTE interface consists of three circuits: CT 103 and 104 for the transmission and reception of both data and control signals and CT 102 for the signal ground or common return. Figure 1/S.19 illustrates the interface configuration.

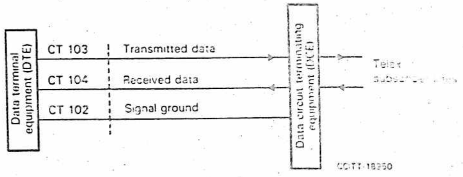

FIGURE 1/S.19

Interface configuration

INTERNATIONAL TELECOMMUNICATION UNION

ITU-T

TELECOMMUNICATION
STANDARDIZATION SECTOR
OF ITU

S.1

(03/93)

TELEGRAPHY

ALPHABETICAL TELEGRAPH TERMINAL EQUIPMENT

INTERNATIONAL TELEGRAPH ALPHABET No. 2

ITU-T Recommendation S.1

(Previously "CCITT Recommendation")

FOREWORD

The ITU Telecommunication Standardization Sector (ITU-T) is a permanent organ of the International Telecommunication Union. The ITU-T is responsible for studying technical, operating and tariff questions and issuing Recommendations on them with a view to standardizing telecommunications on a worldwide basis.

The World Telecommunication Standardization Conference (WTSC), which meets every four years, established the topics for study by the ITU-T Study Groups which, in their turn, produce Recommendations on these topics.

ITU-T Recommendation S.1 was revised by the ITU-T Study Group IX (1988-1993) and was approved by the WTSC (Helsinki, March 1-12, 1993).

NOTES

1 As a consequence of a reform process within the International Telecommunication Union (ITU), the CCITT ceased to exist as of 28 February 1993. In its place, the ITU Telecommunication Standardization Sector (ITU-T) was created as of 1 March 1993. Similarly, in this reform process, the CCIR and the IFRB have been replaced by the Radiocommunication Sector.

In order not to delay publication of this Recommendation, no change has been made in the text to references containing the acronyms "CCITT, CCIR or IFRB" or their associated entities such as Plenary Assembly, Secretariat, etc. Future editions of this Recommendation will contain the proper terminology related to the new ITU structure.

2 In this Recommendation, the expression "Administration" is used for conciseness to indicate both a telecommunication administration and a recognized operating agency.

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INTERNATIONAL TELEGRAPH ALPHABET No. 2

(Malaga-Torremolinos, 1984; amended Melbourne, 1988 and Helsinki, 1993)

1 Introduction

1.1 This Recommendation defines the repertoire of the graphic and control characters used in International Telegraph Alphabet No. 2 (ITA2) and the coded representation of these characters for communication purposes. It also contains provisions concerning the use of certain specific combinations.

1.2 The coded character set of ITA2 is based on a 5-unit-structure.

1.3 ITA2 is also defined in Recommendation F.1 for the international public telegram service, and it is specified in Recommendation F.60 that it should also be used for the telex service. It may also be used for other applications, such as specialized or leased circuits.

1.4 For definitions concerning alphabetic telegraphy, see definitions in Recommendation R.140 and the International Electrotechnical Vocabulary (IEV), Chapter 721.

2 Character repertoire

2.1 Graphic characters that have a corresponding signal in ITA2 are:

- the 26 latin alphabetic characters: A B C D E F G H I J K L M N O P Q R S T U V W X Y Z;
- decimal figures: 0 1 2 3 4 5 6 7 8 9;
- punctuation marks and miscellaneous signs:

Full Stop	.
Comma	,
Colon or division sign	:
Question mark	?
Apostrophe	'
Cross or addition sign	+
Hyphen or dash or subtraction sign	–
Fraction bar or division sign	/
Equal sign or double hyphen	=
Left-hand bracket (parenthesis)	(
Right-hand bracket (parenthesis)	)

2.2 Three graphic characters (such as accented letters and currency signs) may be applied for national or private use (see 4.2).

2.3 This Recommendation does not define the particular printing style, font or case (capital or small letters) of graphic characters, nor does it define the layout of keyboards in teleprinters or similar terminal devices.

2.4 The control characters provided in ITA2 are:

- "Who are you?" (part of the signal to operate the answerback unit of the corresponding installation);
- operation of an audible signal of the corresponding installation;
- carriage return;
- line-feed;

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- letter-shift;
- figure-shift;
- space or blank;
- all-space or null (no tape perforation).

3 Coding

3.1 The 32 combinations available in ITA2 are produced by a sequence of five units, each of which may assume one of two significant conditions (A or Z), as shown in Table 1.

3.2 Condition A corresponds to start polarity, no perforation in paper tape and symbol 0 of the binary notation. Condition Z corresponds to stop polarity, perforation in paper tape and symbol 1 in the binary notation.

For the equivalent frequency and amplitude modulation corresponding to conditions A and Z in voice-frequency telegraph equipment, see Recommendation V.1 and the relevant Series R Recommendations.

NOTES

1 The level and polarity of voltage and current corresponding to conditions A and Z (e.g. on the local end with its termination) are national options and hence are not defined internationally.

2 The terms "start" and "stop", "space" and "mark" have also been used to describe conditions A and Z respectively (see definition 31.37/R.140).

4 Particular combinations

4.1 In accordance with Recommendations S.6, S.8 and the Series U Recommendations, the WRU signal (who are you? combination Nos. 30 and 4) is used to operate the answerback unit of the corresponding instrument in the international telex and gentex services, and may also provide a printed symbol (as in Table 2).

4.2 Since some Administrations assign combination Nos. 6, 7 and 8 in figure case for internal use whereas others do not, it is desirable to avoid varying interpretation in these circumstances that might result if they were used freely in international services. Consequently the use of combination Nos. 6, 7 and 8 in figure case is not defined and therefore should not be used in international services, except by direct agreement between Administrations, and it is recommended

- that, in all services, they should be shown in some special manner on the keyboards; and
- that services in which they are not used should place on the secondary positions on the printing blocks (or on the equivalent mechanism) an arbitrary sign, for the letters F, G and H such as, for instance, a square. The appearance of such sign on the paper is to indicate an abnormal impression.

4.3 Combination No. 10 "audible signal", may also provide a printed symbol (as in Table 2).

4.4 Combinations Nos. 29 and 30, "letter-shift" and "figure-shift", respectively, are used to place the terminal installation in the "letter" or "figure" position, so that

- any combination No. 1 to 26 received engenders a printed signal in the "letter" case (second column of Table 1) if the last shift signal received is a "letter-shift" signal;
- any combination No. 1 to 26 received engenders a printed signal in the "figure" case (third column of Table 1) if the last shift signal received is a "figure-shift" signal", except as noted for combination Nos. 4 and 10 in 4.1 and 4.3.

To ensure that terminal equipments located at both ends of a telex call are in the appropriate shift position, in new terminals, and as far as possible in existing terminals, the first combination to be transmitted, either after reception of characters or when commencing transmission, shall be either "letter-shift" or "figure-shift" (i.e. combination No. 29 or combination No. 30).

4.5 Combinations Nos. 29 (letter-shift), 30 (figure-shift) and 32 (all-space, null or no tape perforation) shall not affect the spacing movement of terminal machines, except where their reception is indicated by printing a symbol, as mentioned in clause 5 below.

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TABLE 1/S.1

International Telegraph Alphabet No. 2 (ITA2)

Combination number	Letter case	Figure case	Coding 1	2	3	4	5
1	A	–	Z	Z	A	A	A
2	B	?	Z	A	A	Z	Z
3	C	:	A	Z	Z	Z	A
4	D	(subclause 4.1)	Z	A	A	Z	A
5	E	3	Z	A	A	A	A
6	F	(subclause 4.2)	Z	A	Z	Z	A
7	G		A	Z	A	Z	Z
8	H		A	A	Z	A	Z
9	I	8	A	Z	Z	A	A
10	J	Audible signal	Z	Z	A	Z	A
11	K	(	Z	Z	Z	Z	A
12	L	)	A	Z	A	A	Z
13	M	.	A	A	Z	Z	Z
14	N	,	A	A	Z	Z	A
15	O	9	A	A	A	Z	Z
16	P	0	A	Z	Z	A	Z
17	Q	1	Z	Z	Z	A	Z
18	R	4	A	Z	A	Z	A
19	S	'	Z	A	Z	A	A
20	T	5	A	A	A	A	Z
21	U	7	Z	Z	Z	A	A
22	V	=	A	Z	Z	Z	Z
23	W	2	Z	Z	A	A	Z
24	X	/	Z	A	Z	Z	Z
25	Y	6	Z	A	Z	A	Z
26	Z	+	Z	A	A	A	Z
27	Carriage-return		A	A	A	Z	A
28	Line-feed		A	Z	A	A	A
29	Letter-shift	(subclause 4.5)	Z	Z	Z	Z	Z
30	Figure-shift		Z	Z	A	Z	Z
31	Space		A	A	Z	A	A
32	(subclause 4.7)		A	A	A	A	A

NOTE – In serial transmission, code element 1 is transmitted first.

4.6 Use of capital and small letters

4.6.1 In ITA2, it is possible to use teleprinters with two series of letter characters, capital and small letters.

4.6.2 It is possible to use sequences of the shift combinations of ITA2 for transfer from one series to the other

4.6.3 If this possibility is used, it is essential to obtain compatibility with teleprinters having only one series of letter characters.

4.7 Use of combination No. 32

4.7.1 Combination No. 32 can be used in certain sequences of switching signals; these uses are set out in Recommendations U.11, U.20, U.22 and S.4.

4.7.2 Combination No. 32 must not be used during the phase of communication (after a call is set up) in the international telex service.

4.7.3 Combination No. 32 can be used during the phase of communication after a call is set up in domestic national service or by bilateral agreement between two Administrations, as a command signal for certain functions, e.g. transfer to a national alphabet other than ITA2.

4.7.4 Combination No. 32 must not be used for transfer from one form of characters to another while remaining within ITA2, nor for transfer from one international telegraph alphabet to another.

5 Graphic representation of control characters

Where a graphic indication of the reception or transmission of certain control characters is required, this should be effected by printing the symbols shown in Table 2.

TABLE 2/S.1

Printed symbols for control characters

Function	Combination No.	Case	Symbol	Alphabetical representation
Who are you? (WRU)	4	Figure	✠ (Note 1)	EQ
Audible signal (bell)	10	Figure	⍾	BL
Carriage-return	27	Either	←	CR
Line-feed	28	Either	≡	LF
Letter-shift	29	Either	↓	SL or LS
Figure-shift	30	Either	↑	SF or FS
Space	31	Either	△	SP
All-space: Null	32	Either	⊏	NU

NOTES

1 The pictorial representation shown is a schematic of ✠, which may also be used when equipment allows.

2 Each alphabetical representation is to be considered as a single symbol. It may occupy one position on a printed or displayed line.

INTERNATIONAL TELECOMMUNICATION UNION

CCITT

THE INTERNATIONAL
TELEGRAPH AND TELEPHONE
CONSULTATIVE COMMITTEE

T.50
(09/92)

TERMINAL EQUIPMENT AND PROTOCOLS FOR TELEMATIC SERVICES

INTERNATIONAL REFERENCE ALPHABET (IRA)

(FORMERLY INTERNATIONAL ALPHABET No. 5 or IA5)

INFORMATION TECHNOLOGY – 7-BIT CODED CHARACTER SET FOR INFORMATION INTERCHANGE

Recommendation T.50

FOREWORD

The CCITT (the International Telegraph and Telephone Consultative Committee) is a permanent organ of the International Telecommunication Union (ITU). CCITT is responsible for studying technical, operating and tariff questions and issuing Recommendations on them with a view to standardizing telecommunications on a worldwide basis.

The Plenary Assembly of CCITT which meets every four years, establishes the topics for study and approves Recommendations prepared by its Study Groups. The approval of Recommendations by the members of CCITT between Plenary Assemblies is covered by the procedure laid down in CCITT Resolution No. 2 (Melbourne, 1988).

Recommendation (revised) T.50 was prepared by Study Group VIII and was approved under the Resolution No. 2 procedure on the 18th of September 1992.

CCITT NOTES

1) In this Recommendation, the expression "Administration" is used for conciseness to indicate both a telecommunication administration and a recognized private operating agency.

2) A list of abbreviations used in this Recommendation can be found in Annex C.

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INTERNATIONAL REFERENCE ALPHABET (IRA)

(Formerly International Alphabet No. 5 or IA5)

Information technology – 7-bit coded character set for information interchange

(revised 1992)

1 Scope

1.1 This Recommendation specifies a set of 128 characters, (control characters and graphic characters such as letters, digits and symbols) with their coded representation. Most of these characters are mandatory and unchangeable, but provision is made for some flexibility to accommodate national and other requirements.

1.2 This Recommendation specifies a 7-bit coded character set with a number of options. It also provides guidance on how to exercise the options to define specific national versions and application-oriented versions. Furthermore, it specifies the International Reference Version (IRV) in which such options have been exercised.

1.3 This character set is primarily intended for the interchange of information among data processing systems and associated equipment, and within data communication systems. The need for graphic characters and control functions in data processing has also been taken into account in determining this character set.

1.4 This character set is applicable to alphabets of the Latin script.

1.5 This character set allows the use of control characters for code extension where its character set is insufficient for particular applications. Procedures for the use of these control characters are specified in ISO 2022.

1.6 The definitions of the control characters mentioned in this Recommendation are specified in Annex A. It is assumed that data associated with them are to be processed serially in a forward direction. When they are included in strings of data which are processed other than serially in a forward direction, or when they are included in data formatted for fixed-record processing, they may have undesirable effects or may require additional special treatment to ensure that they result in their desired function.

1.7 This is a paired Recommendation/International Standard, equivalent in technical content to ISO/IEC 646 (1991).

2 Conformance and implementation

2.1 *Conformance*

2.1.1 *Conformance of information interchange*

A coded-character-data-element (CC-data-element) within coded information for interchange is in conformance with this Recommendation if all the coded representations of characters within that CC-data-element conform to the requirements of § 8.1.

A claim of conformance shall identify the version adopted in accordance with §§ 8.2 to 8.4.

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2.1.2 *Conformance of devices*

A device is in conformance with this Recommendation if it conforms to the requirements of § 2.1.2.1, and either or both of §§ 2.1.2.2 and 2.1.2.3 below. A claim of conformance shall identify the version adopted.

2.1.2.1 *Device description*

A device that conforms to this Recommendation shall be the subject of a description that identifies the means by which the user may supply characters to the device, or may recognize them when they are made available to the user, as specified respectively in §§ 2.1.2.2 and 2.1.2.3 below.

2.1.2.2 *Originating devices*

An originating device shall allow its user to supply any sequence of characters from the version adopted, and shall be capable of transmitting their coded representations within a CC-data-element.

2.1.2.3 *Receiving devices*

A receiving device shall be capable of receiving and interpreting any coded representations of characters that are within a CC-data-element, and that conform to § 2.1.1, and shall make the corresponding characters available to its user in such a way that the user can identify them from among those of the version adopted, and can distinguish them from each other.

2.2 *Implementation*

The use of this character set requires definitions of its implementation in various media. For example, these could include punched tapes, punched cards, magnetic and optical interchangeable media and transmission channels, thus permitting interchange of data to take place either indirectly by means of an intermediate recording on a physical medium, or by local connection of various units (such as input and output devices and computers) or by means of data transmission equipment.

The implementation of this coded character set in physical media and for transmission, taking into account the need for error checking, is the subject of other Recommendations.

3 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this Recommendation are encouraged to investigate the possibility of applying the most recent editions of the standards listed below.

ISO 2022: 1986 *Information processing – ISO 7-bit and 8-bit coded character sets – Coded extension techniques.*

4 Definitions

For the purpose of this Recommendation the following definitions apply.

4.1 active position

The character position which is to image the graphic symbol representing the next graphic character or relative to which the next control function is to be executed.

Note – In general, the active position is indicated by a cursor.

4.2 bit combination

An ordered set of bits used for the representation of characters.

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4.3 **character**

A member of a set of elements used for the organization, control or representation of data.

4.4 **character position**

The portion of a display that is imaging or is capable of imaging a graphic symbol.

4.5 **coded character set; code**

A set of unambiguous rules that establishes a character set and the one-to-one relationship between the characters of the set and their representation by one or more bit combinations.

4.6 **coded character-data-element (CC-data-element)**

An element of interchanged information that is specified to consist of a sequence of coded representations of characters, in accordance with one or more identified standards for coded character sets.

Note 1 – In a communication environment according to the Reference Model for Open Systems Interconnection of Recommendation X.200 (ISO 7498) a CC-data-element will form all or part of the information that corresponds to the application user data and the presentation protocol data unit (PPDU) defined in that Recommendation.

Note 2 – When information interchange is accomplished by means of interchangeable media, a CC-data-element will form all or part of the information that corresponds to the user data, and not that recorded during formatting and initialization.

4.7 **code extension**

The techniques for the encoding of characters that are not included in the character set of a given code.

4.8 **code table**

A table showing the character allocated to each bit combination in a code.

4.9 **control character**

A control function the coded representation of which consists of a single bit combination.

4.10 **control function**

An action that affects the recording, processing, transmission or interpretation of data and that has a coded representation consisting of one or more combinations.

4.11 **device**

A component of information processing equipment which can transmit, and/or can receive, coded information within CC-data-elements.

Note – It may be an input/output device in the conventional sense, or a process such as an application program or gateway function.

4.12 **graphic character**

A character, other than a control function, that has a visual representation normally handwritten, printed or displayed, and that has a coded representation consisting of one or more bit combinations.

4.13 **graphic symbol**

A visual representation of a graphic character or of a control function.

4.14 **position**

That part of a code table identified by its column and row co-ordinates.

4.15 **repertoire**

A specified set of characters that are represented by means of one or more bit combinations of a coded character set.

4.16 **user**

A person or other entity that invokes the services provided by a device.

Note 1 – This entity may be a process such as an application program if the "device" is a code convertor or a gateway function, for example.

Note 2 – The characters, as supplied by the user or made available to the user, may be in the form of codes local to the device, or of non-conventional visible representations, provided that § 2.1.2 above is satisfied.

5 Notation, code table and names

5.1 *Notation*

The bits of the bit combinations of the 7-bit code are identified by b_7, b_6, b_5, b_4, b_3, b_2, and b_1, where b_7 is the highest-order, or most-significant, bit and b_1 is the lowest order, or least-significant, bit.

The bit combination may be interpreted to represent integers in the range 0 to 127 in binary notation by attributing the following weights to the individual bits:

Bit	b_7	b_6	b_5	b_4	b_3	b_2	b_1
Weight	64	32	16	8	4	2	1

In this Recommendation, the bit combinations are identified by notations of the form x/y, where x is a number in the range 0 to 7 and y is a number in the range 0 to 15. The correspondence between the notations of the form x/y and the bit combinations consisting of the bits b_7 to b_1 is as follows:

- x is the number represented by b_7, b_6, and b_5, where these bits are given the weights 4, 2 and 1 respectively;
- y is the number represented by b_4, b_3, b_2, and b_1, where these bits are given the weights 8, 4, 2 and 1 respectively.

The notations of the form x/y are the same as those used to identify code table positions, where x is the column number and y the row number (see § 9).

5.2 *Code table*

A 7-bit code table consists of 128 positions arranged in 8 columns and 16 rows. The columns are numbered 0 to 7 and rows 0 to 15.

The code table positions are identified by notations of the form *x/y*, where *x* is the column number and *y* is the row number.

The position of the code table is in one-to-one correspondence with the bit combinations of the code. The notation of a code table position, of the form *x/y*, is the same as that of the corresponding bit combination.

The allocation of individual characters to the bit combinations of the 7-bit code is specified in §§ 6.2 to 6.5.

5.3 *Names*

This Recommendation assigns one name to each character. In addition, it specifies an acronym for each control character and for the character SPACE, and a graphic symbol for each graphic character. By convention, only capital letters, space and hyphen are used for writing the names of the characters. For acronyms only capital letters and digits are used. It is intended that the acronyms and this convention be retained in all translation of the text.

The names chosen to denote graphic characters are intended to reflect their customary meaning. However, this Recommendation does not define and does not restrict the meanings of graphic characters. Neither does it specify a particular style or font design for the graphic characters when imaged.

6 Specification of the coded character set

6.1 *Structure*

The coded character set of this Recommendation shall have the following structure:

- a C0 control character set of up to 32 control characters allocated to positions 0/0 to 1/15;
- the graphic character SPACE (SP) allocated to position 2/0;
- a G0 graphic character set of up to 94 graphic characters allocated to positions 2/1 to 7/14;
- the character DELETE (DEL) allocated to position 7/15.

6.2 *Control characters*

The control characters allocated to positions 0/0 to 1/15 shall be as specified in Annex A.

6.3 *Character SPACE*

The acronym of the character SPACE is SP and its coded representation is 2/0.

This character is a graphic character; it has a visual representation consisting of the absence of a graphic symbol.

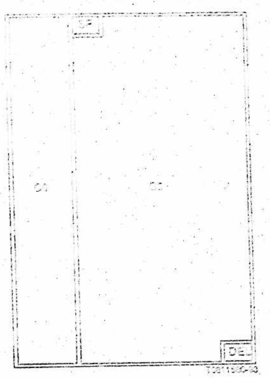

FIGURE 1/T.50

Structure of the 7-bit coded character set

6.4 *Graphic characters*

The 94-bit combinations 2/1 to 7/14 are used for the representation of graphic characters as specified in §§ 6.4.1, 6.4.2 and 6.4.3.

All graphic characters shall be spacing characters, that is, they cause the active position to advance by one character position.

6.4.1 *Unique graphic character allocations*

A unique graphic character is allocated to each of the 82-bit combinations 2/1, 2/2, 2/5 to 3/15, 4/1 to 5/10, 5/15 and 6/1 to 7/10. These characters are specified in Table 1/T.50.

6.4.2 *Alternative graphic character allocations*

Two alternative graphic characters are allocated to each of the bit combinations 2/3 and 2/4. These characters are specified in Table 2/T.50.

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TABLE 1/T.50

Unique graphic character allocations

Graphic symbol	Name	Coded representation
!	Exclamation mark	2/1
"	Quotation mark	2/2
%	Percent sign	2/5
&	Ampersand	2/6
'	Apostrophe	2/7
(	Left parenthesis	2/8
)	Right parenthesis	2/9
*	Asterisk	2/10
+	Plus sign	2/11
,	Comma	2/12
-	Hyphen, minus sign	2/13
.	Full stop	2/14
/	Solidus	2/15
0	Digit zero	3/0
1	Digit one	3/1
2	Digit two	3/2
3	Digit three	3/3
4	Digit four	3/4
5	Digit five	3/5
6	Digit six	3/6
7	Digit seven	3/7
8	Digit eight	3/8
9	Digit nine	3/9
:	Colon	3/10
;	Semicolon	3/11
<	Less-than sign	3/12
=	Equals sign	3/13
>	Greater-than sign	3/14
?	Question mark	3/15
A	Latin capital letter A	4/1
B	Latin capital letter B	4/2
C	Latin capital letter C	4/3
D	Latin capital letter D	4/4
E	Latin capital letter E	4/5
F	Latin capital letter F	4/6
G	Latin capital letter G	4/7
H	Latin capital letter H	4/8
I	Latin capital letter I	4/9
J	Latin capital letter J	4/10
K	Latin capital letter K	4/11
L	Latin capital letter L	4/12
M	Latin capital letter M	4/13
N	Latin capital letter N	4/14
O	Latin capital letter O	4/15
P	Latin capital letter P	5/0
Q	Latin capital letter Q	5/1
R	Latin capital letter R	5/2
S	Latin capital letter S	5/3
T	Latin capital letter T	5/4
U	Latin capital letter U	5/5
V	Latin capital letter V	5/6
W	Latin capital letter W	5/7
X	Latin capital letter X	5/8
Y	Latin capital letter Y	5/9
Z	Latin capital letter Z	5/10
_	Low line, underline	5/15
a	Latin small letter a	6/1
b	Latin small letter b	6/2
c	Latin small letter c	6/3
d	Latin small letter d	6/4
e	Latin small letter e	6/5
f	Latin small letter f	6/6
g	Latin small letter g	6/7
h	Latin small letter h	6/8
i	Latin small letter i	6/9
j	Latin small letter j	6/10
k	Latin small letter k	6/11
l	Latin small letter l	6/12
m	Latin small letter m	6/13
n	Latin small letter n	6/14
o	Latin small letter o	6/15
p	Latin small letter p	7/0
q	Latin small letter q	7/1
r	Latin small letter r	7/2
s	Latin small letter s	7/3
t	Latin small letter t	7/4
u	Latin small letter u	7/5
v	Latin small letter v	7/6
w	Latin small letter w	7/7
x	Latin small letter x	7/8
y	Latin small letter y	7/9
z	Latin small letter z	7/10

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TABLE 2/T.50

Alternative graphic character allocations

Graphic symbol	Name	Coded representation
£	Pound sign	2/3
#	Number sign	2/3
$	Dollar sign	2/4
¤	Currency sign	2/4

Either the character POUND SIGN or the character NUMBER SIGN shall be allocated to bit combination 2/3 and either the character DOLLAR SIGN or the character CURRENCY SIGN shall be allocated to bit combination 2/4 (see § 8).

Unless otherwise agreed between sender and recipient, the graphic symbols £, $, ¤ do not designate the currency of a specific country.

6.4.3 *National or application-oriented graphic character allocations*

No specific graphic character is allocated to the ten bit combinations 4/0, 5/11 to 5/14, 6/0 and 7/11 to 7/14. These bit combinations are available for national or application-oriented use. Either a unique graphic character shall be allocated to each of these bit combinations, or the bit combination shall be declared unused (see § 8.1).

6.5 *Character DELETE*

The acronym of the character DELETE is DEL and its coded representation is 7/15. DEL was originally used to erase or obliterate an erroneous or unwanted character in punched tape. DEL may be used for media-fill or time-fill. DEL characters may be inserted into, or removed from, a data stream withou [illegible] he information content of that stream, but such action may affect the information layout and/or the control c [illegible] nt.

7 Composite graphic characters

Whilst all graphic characters specified in this Recommendation are spacing characters, it is possible, by using BACKSPACE or CARRIAGE RETURN to image two or more graphic characters at the same character position (see also § B.2).

For example, SOLIDUS and EQUALS SIGN may be combined to image "not equals". The character LOW LINE, that may be used as a free-standing character, may also be associated with other character(s) to represent the graphic rendition "underlined".

Diacritical marks may be allocated to the bit combinations specified in § 6.4.3 and be available for composing accented letters. For such composition a sequence of three characters, the first or last of which is the letter to be accented and the second of which is BACKSPACE may be used. Furthermore, QUOTATION MARK, APOSTROPHE or COMMA can be associated with a letter by means of BACKSPACE for the composition of an accented letter with a diaeresis, an acute accent or a cedilla, respectively.

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8 Versions of the coded character set

8.1 *General*

The basic code table is shown in Table 4/T.50.

In order to use the 7-bit coded character set for information interchange, it is necessary to exercise the options left open in § 6:

- to specify the C0 set of control characters according to Annex A;
- to specify the G0 set:
  - to allocate to each of the bit combinations 2/3 and 2/4 one of the alternative graphic characters specified in § 6.4.2;
  - to allocate to each of the bit combinations 4/0, 5/11 to 5/14, 6/0 and 7/11 to 7/14 a unique graphic character, or to declare the bit combination unused.

A graphic character allocated to a bit combination specified in §§ 6.4.1 and 6.4.2 shall not be allocated to any other bit combination. For example, the POUND SIGN, if not allocated to bit combination 2/3, shall not be allocated to any other bit combination.

A character set completed in this way is called a "version of T.50".

8.2 *International Reference Version (IRV)*

This version is available for use when there is no requirement to use a national or an application-oriented version. In information interchange, the IRV is assumed unless an agreement exists between sender and recipient of the data (see also § 10). The graphic characters allocated to the G0 set of the IRV shall be as specified in Tables 1/T.50 and 3/T.50. See Table 5/T.50. Agreement between sender and recipient of the data shall be required if composite characters are used.

The C0 set of the IRV is as specified in Annex A.

TABLE 3/T.50

IRV graphic character allocations

Graphic Symbol	Name	Coded representation
#	Number sign	2/3
$	Dollar sign	2/4
@	Commercial at	4/0
[	Left square bracket	5/11
\	Reverse solidus	5/12
]	Right square bracket	5/13
^	Circumflex accent	5/14
`	Grave accent	6/0
{	Left curly bracket	7/11
|	Vertical line	7/12
}	Right curly bracket	7/13
‾	Tilde	7/14

8.3 *National versions*

8.3.1 The responsibility for defining national versions lies with the national standardization bodies. These bodies shall exercise the options available and make the required selection (see Annex B).

8.3.2 When required, more than one national version can be defined within a country. The different versions shall be separately identified. In particular, when alternative graphic characters are required, for a given bit combination, for example 5/12, two different versions shall be identified, even if they differ only by this single character.

8.3.3 If, in a country, there is no special demand for specific graphic characters, it is strongly recommended that the characters of the G0 set of the International Reference Version (IRV) be selected and allocated to the same bit combinations as in the IRV.

However, when graphic characters that are different from the characters of the IRV are required, they shall have distinct forms and be given distinctive names which are not in conflict with any of the forms or the names of any of the graphic characters in the IRV.

8.4 *Application-oriented versions*

Within national or international industries, organizations or professional groups, application-oriented versions may be used. They require precise agreement among the interested parties, who will have to exercise the options available and to make the required selection.

9 Identification of versions

9.1 *Purpose and context of identification*

CC-data-elements conforming to a version of this Recommendation are intended to form all or part of a composite unit of coded information that is interchanged between an originator and a recipient. The identification of the version of this Recommendation that has been adopted by the originator shall also be available to the recipient. The route by which such identification is communicated to the recipient is outside the scope of this Recommendation.

However, some standards for interchange of coded information may permit, or require, that the coded representation of the identification applicable to the CC-data-elements forms a part of the interchanged information. This clause specifies a coded representation for the identification of a version of this Recommendation. Such coded representation form all or part of an identifying data element, which may be included in information interchange in accordance with the relevant standard.

9.2 *Identification of a version*

The identification of a version of this Recommendation shall comprise a set of identifications, one for the C0 set and G0 set that constitute the version. Each identification in the set shall consist of a designating escape sequence of the type shown below:

- ESC 2/1 F shall identify the C0 set;
- ESC 2/8 F shall identify the G0 set.

The final byte F of these escape sequence shall be obtained from the International Register ISO 2375. If the C0 set is empty, the identification shall be the same escape sequence in which the Final byte F is 7/14.

The IRV shall be identified by the following escape sequences:

- Registration ISO IR No. 1: ESC 2/1 4/0;
- Registration ISO IR No. 6: ESC 2/8 4/2.

Note – This IRV defers from the previous IRV of IA5.

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10 Explanation of code Tables 4/T.50 and 5/T.50

Table 4/T.50 is the basic 7-bit code table. It shows the 7-bit coded character set specified in § 5 and indicates the options related to alternative graphic characters (see § 6.4.2) and national or application-oriented use (see § 6.4.3).

Positions 0/0 to 1/15 reserved for control characters are shown empty. Positions 2/0 to 7/15 contain a graphic symbol, an acronym, or a reference to a section of this Recommendation. A reference to §§ 6.4.2 and 6.4.3 is denoted by 1 or 2 respectively.

Table 5/T.50 is a code table showing a version which includes the G0 set of the IRV and no C0 set.

TABLE 4/T.50

Basic code table

				b_7	0	0	0	0	1	1	1	1
				b_6	0	0	1	1	0	0	1	1
				b_5	0	1	0	1	0	1	0	1
b_4	b_3	b_2	b_1		0	1	2	3	4	5	6	7
0	0	0	0	0			SP	0	②	P	②	p
0	0	0	1	1			!	1	A	Q	a	q
0	0	1	0	2			"	2	B	R	b	r
0	0	1	1	3			#/£ ②	3	C	S	c	s
0	1	0	0	4			¤/$ ①	4	D	T	d	t
0	1	0	1	5			%	5	E	U	e	u
0	1	1	0	6			&	6	F	V	f	v
0	1	1	1	7			'	7	G	W	g	w
1	0	0	0	8			(	8	H	X	h	x
1	0	0	1	9			)	9	I	Y	i	y
1	0	1	0	10			*	:	J	Z	j	z
1	0	1	1	11			+	;	K	②	k	②
1	1	0	0	12			,	<	L	②	l	②
1	1	0	1	13			–	=	M	②	m	②
1	1	1	0	14			.	>	N	②	n	②
1	1	1	1	15			/	?	O	_	o	DEL

C0 set

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TABLE 5/T.50

Version with the G0 set of the IRV

				b_7	0	0	0	0	1	1	1	1
				b_6	0	0	1	1	0	0	1	1
				b_5	0	1	0	1	0	1	0	1
b_4	b_3	b_2	b_1		0	1	2	3	4	5	6	7
0	0	0	0	0			SP	0	@	P	`	p
0	0	0	1	1			!	1	A	Q	a	q
0	0	1	0	2			"	2	B	R	b	r
0	0	1	1	3			#	3	C	S	c	s
0	1	0	0	4			$	4	D	T	d	t
0	1	0	1	5			%	5	E	U	e	u
0	1	1	0	6			&	6	F	V	f	v
0	1	1	1	7			'	7	G	W	g	w
1	0	0	0	8			(	8	H	X	h	x
1	0	0	1	9			)	9	I	Y	i	y
1	0	1	0	10			*	:	J	Z	j	z
1	0	1	1	11			+	;	K	[	k	{
1	1	0	0	12			,	<	L	\	l	|
1	1	0	1	13			–	=	M	[illegible]	[illegible]	}
1	1	1	0	14			.	>	N	^	n	~
1	1	1	1	15			/	?	O	_	o	DEL

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ANNEX A

(to Recommendation T.50)

(Normative)

Specification of the C0 set

A.1 *Definition of control set*

Table A-1/T.50 shows the C0 set.

The control characters are listed below in the alphabetical order of their acronyms.

A.1.1 ACK acknowledge

A transmission control character transmitted by a receiver as an affirmative response to the sender.

A.1.2 BEL bell

A control character that is used when there is a need to call for attention; it may control alarm or attention devices.

A.1.3 BS backspace

A format effector which causes the active position to move one character position in the direction opposite to the transmission of one or more texts.

A.1.4 CAN cancel

A character, or the first character of a sequence, indicating that the data preceding it is in error. As a result, this data shall be ignored. The specific meaning of this character shall be defined for each application and/or between sender and recipient.

A.1.5 CR carriage return

A format effector which causes the active position to move to the line home position on the same line.

A.1.6 DC1 device control one

A device control character which is primarily intended for turning on or starting an ancillary device. If it is not required for this purpose, it may be used to restore a device to the basic mode of operation (see also DC2 and DC3), or for any other device control function not provided by other DCs. When used for data flow control, DC1 is sometimes called "X-ON".

A.1.7 DC2 device control two

A device control character which is primarily intended for turning on or starting an ancillary device. If it is not required for this purpose, it may be used to set a device to a special mode of operation (in which case DC1 is used to restore the device to the basic mode), or for any other device control function not provided by other DCs.

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A.1.8 DC3 device control three

A device control character which is primarily intended for turning off or stopping an ancillary device. This function may be a secondary level stop, for example wait, pause, stand-by or halt (in which case DC1 is used to restore normal operation). If it is not required for this purpose, it may be used for any other ancillary device control function not provided by other DCs. When used for data flow control, DC3 is sometimes called "X-OFF".

A.1.9 DC4 device control four

A device control character which is primarily intended for turning off, stopping or interrupting an ancillary device. If it is not required for this purpose, it may be used for any other device control function not provided by other DCs.

A.1.10 DEL delete

A character used primarily to erase or obliterate an erroneous or unwanted character in punched tape. DEL characters may also serve to accomplish media-fill or time-fill. They may be inserted into, or removed from, a stream of data without affecting the information content of that stream, but such action may affect the information layout and/or the control of equipment.

A.1.11 DLE data link escape

A transmission control character which will change the meaning of a limited number of contiguously following bit combinations. It is used exclusively to provide supplementary transmission control functions. Only graphic characters and transmission control characters can be used in DLE sequences.

A.1.12 EM end of medium

A control character that may be used to identify the physical end of a medium, or the end of the used portion of a medium, or the end of the wanted portion of data recorded on a medium.

A.1.13 ENQ enquiry

A transmission control character used as a request for a response from a remote station – the response may include station identification and/or station status. When a "Who are you" function is [illegible] the general switched transmission network the first use of ENQ after the connection is established shall ha[illegible]ning "Who are you" (station identification). Subsequent use of ENQ may, or may not, include the function "Who are you", as determined by agreement.

A.1.14 EOT end of transmission

A transmission control character used to indicate the conclusion of the transmission of one or more text.

A.1.15 ESC escape

A control character which is used for code extension purposes. It causes the meanings of a limited number of bit combinations following it in the data stream to be changed. The use of ESC is defined in ISO 2022.

A.1.16 ETB end of transmission block

A transmission control character used to indicate the end of a transmission block of data where data is divided into such blocks for transmission purposes.

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A.1.17 ETX end of text

A transmission control character which indicates the end of a text.

A.1.18 FF form [illegible]

A format effector which causes the active position to advance to the corresponding character position on a pre-determined line of the next form or page.

A.1.19 HT horizontal tabulation

A format effector which causes the active position to advance to the next pre-determined character position.

A.1.20 IS1 (US) Information separator one (Unit separator)

A control character used to separate and qualify data logically; its specific meaning has to be defined for each application. If this character is used in hierarchical order as specified in the general definition of IS, it delimits a data item called a unit.

A.1.21 IS2 (RS) Information separator two (Record separator)

A control character used to separate and qualify data logically; its specific meaning has to be defined for each application. If this character is used in hierarchical order as specified in the general definition of IS, it delimits a data item called a record.

A.1.22 IS3 (GS) Information separator three (Group separator)

A control character used to separate and qualify data logically; its specific meaning has to be defined for each application. If this character is used in hierarchical order as specified in the general definition of IS, it delimits a data item called a group.

A.1.23 IS4 (FS) Information separator four (File separator)

A control character used to separate and qualify data logically; its specific meaning has to be defined for each application. If this character is used in hierarchical order as specified in the general definition of IS, it delimits a data item called a file.

A.1.24 LF line feed

A format effector which causes the active position to advance to the corresponding character position of the next line.

A.1.25 NAK negative acknowledge

A transmission control character transmitted by a receiver as a negative response to the sender.

A.1.26 NUL null

A control character used to accomplish media-fill or time-fill. NUL characters may be inserted into, or removed from, a stream of data without affecting the information content of that stream, but such action may affect the information layout and/or the control of equipment.

A.1.27 SI shift-in

A control character which is used for code extension purposes. It causes the meanings of the bit combinations following it in the data stream to be changed. The use of SI is defined in ISO 2022.

A.1.28 SO shift-out

A control character which is used for code extension purposes. It causes the meanings of the bit combinations following it in the data stream to be changed. The use of SO is defined in ISO 2022.

A.1.29 SOH start of heading

A transmission control character used as the first character of a heading of an information message.

A.1.30 STX start of text

A transmission control character which is used to indicate the beginning of a text and the end of a heading.

A.1.31 SUB substitute character

A control character used in the place of a character that has been found to be invalid or in error. SUB is intended to be introduced by automatic means.

A.1.32 SYN synchronous idle

A transmission control character used by a synchronous transmission system in the absence of any other character (idle condition) to provide a signal from which synchronism may be achieved or retained between data terminal equipment.

A.1.33 VT vertical tabulation

A format effector which causes the active position to advance to the corresponding character position on the next pre-determined line.

A.2 *C0 set of a version of Recommendation T.50*

The C0 set of a version of this Recommendation shall be a subset of the C0 set defined in § A.1. Code positions corresponding to control functions not selected shall be declared unused.

A.3 *C0 set of the International Reference Version (IRV)*

The C0 set of the International Reference Version (IRV) is as shown in Table A-

TABLE A-1/T.50

C0 set of the IRV

				b_7	0	0
				b_6	0	0
				b_5	0	1
					0	1
b_4	b_3	b_2	b_1			
0	0	0	0	0	NUL	DLE
0	0	0	1	1	SOH	DC1
0	0	1	0	2	STX	DC2
0	0	1	1	3	ETX	DC3
0	1	0	0	4	EOT	DC4
0	1	0	1	5	ENQ	NAK
0	1	1	0	6	ACK	SYN
0	1	1	1	7	BEL	ETB
1	0	0	0	8	BS	CAN
1	0	0	1	9	HT	EM
1	0	1	0	10	LF	SUB
1	0	1	1	11	VT	ESC
1	1	0	0	12	FF	IS4
1	1	0	1	13	CR	IS3
1	1	1	0	14	SO	IS2
1	1	1	1	15	SI	IS1

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ANNEX B

(to Recommendation T.50)

(Informative)

Guidelines for standards derived from Recommendation T.50

B.1 *General*

When drafting national or application-oriented standards based on this Recommendation, it is recommended that the following considerations be taken into account.

B.2 *Structure of a standard*

It is recommended that the same structure and editorial style as implemented for this Recommendation be adopted. All facilities, restrictions and specifications of the standard should be stated clearly in sentences using plain language, rather than being summarized in tables with notes.

B.2.1 *Control functions*

The standard should contain the selection of control characters from the C0 set and an explicit description of the corresponding control functions. Even where the descriptions are identical with those of this Recommendation, they should be stated explicitly, and not merely by reference to this Recommendation. For application-oriented standards the specific meaning of the Information Separators and of the Device Controls should be defined.

B.2.2 *Graphic characters* (see § 8.3.3)

Where there is no need for particular characters, the graphic characters of the International Reference Version (IRV) should be allocated to the same positions and with the same names as in this Recommendation.

B.2.3 *Composite graphic characters and repertoire*

This Recommendation permits the construction of composite graphic characters by using the control characters BACKSPACE and CARRIAGE RETURN to image two or more graphic characters at the same character position.

The total number of graphic characters which can be obtained from any version of the character set, with or without using this facility, is called the repertoire. This Recommendation does not define a particular repertoire. However, as the interpretation and/or the imaging of composite characters may cause difficulties, agreement between sender and recipient of the data may be required. To minimize the need for such agreements and to facilitate interchange, national or application-oriented standards may specify a standard repertoire of graphic characters which permit only a limited number of composite graphic characters. Such limitations are considered fully compatible with this Recommendation.

B.2.4 *Versions*

In a standard, one or more versions can be specified. It should be noted that a version is not a standard but only part of a standard. The standard itself consists of the C0 set and the well-defined version or versions and a set of clauses as mentioned above. The definition of a version requires that the options mentioned in § 8.1 be properly exercised.

ANNEX C

(to Recommendation T.50)

Alphabetical list of abbreviations used in this Recommendation

ACK	Acknowledge
BEL	Bell
BS	Backspace
CAN	Cancel
CR	Carriage return
DC1	Device control one
DC2	Device control two
DC3	Device control three
DC4	Device control four
DEL	DELETE
DEL	Delete
DLE	Data link escape
EM	End of medium
ENQ	Enquiry
EOT	End of transmission
ESC	Escape
ETB	End of transmission block
ETX	End of text
FF	Form feed
FS	File separator
GS	Group separator
HT	Horizontal tabulation
IA5	International Alphabet No. 5
IRA	International reference alphabet
IRV	International reference version
IS1	Information separator one
IS2	Information separator two
IS3	Information separator three
IS4	Information separator four
LF	Line feed
NAK	Negative acknowledge

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[illegible]	[illegible]
RS	Record separator
SI	Shift-in
SO	Shift-out
SOH	Start of heading
SP	SPACE
STX	Start of text
SUB	Substitute character
SYN	Synchronous idle
US	Unit separator
VT	Vertical tabulation

TECHNICAL INDEXES E1

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TEC

MIL-STD-188C
24 November 1969

SUPERSEDING
MIL-STD-188B
24 February 1964
and Change Notice 1
9 August 1966

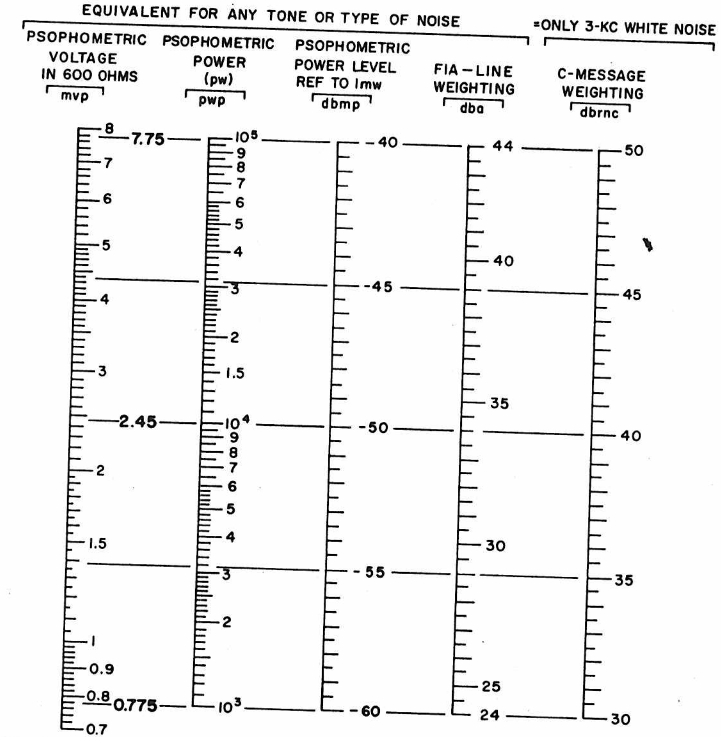
5422

MILITARY STANDARD

MILITARY COMMUNICATION SYSTEM TECHNICAL STANDARDS

DEPARTMENT OF DEFENSE
UNITED STATES OF AMERICA

FSC - MISC



[20 LOG$_{10}$(mvp) - 57.8] = [10 LOG$_{10}$(pwp) - 90] = [dbmp] = [dba - 84] = [dbrnc - 90]

BASIS FOR CHART CONSTRUCTION

A dbm, PSOPH WTD (dbmp) = dba - 84

B ONE mw UNWEIGHTED 3-kc WHITE NOISE READS + 82 dbc = + 88.5 dbrnc (C-MESSAGE), ROUNDED OFF TO: + 88.0 dbrnc.

C. ONE mw INTO 600 OHMS = 775 MILLIVOLTS = 0 dbm = 10^9 PICOWATTS.

READINGS OF NOISE MEASURING SETS WHEN CALIBRATED ON ONE MILLIWATT OF TEST TONE:
FIA- LINE: AT 1000 Hz READS + 85 dba
C-MESSAGE: AT 1000 Hz READS + 90 dbrn
PSOPHOMETER (1951), 800 Hz READS 0 dbm

CHART IS ADAPTABLE TO RANGES A THROUGH E WITH LIMITS AS FOLLOWS:

	mvp	pwp	dbmp	dba	dbrnc
A	775.	10^9	0	+84	90
B	77.5	10^7	-20	+64	70
C	7.75	10^5	-40	+44	50
D	0.775	10^3	-60	+24	30
E	0.0775	10	-80	+ 4	10
	0.0245	1	-90	- 6	0

TABLE III

APPENDIX C

CODED CHARACTER SETS (ALPHABETS)

1. INTRODUCTION. Teletypewriter message transmission systems have been used in Department of Defense communications for a number of years and are expected to be used for some time. The five unit teletypewriter coded character set (see table 3) used throughout these systems has for many years been established as a standard and is included in this publication as an interim standard since it will remain in use for an undetermined interval. In the past decade, an extensive automatic electronic information processing industry has been developed. Numerous codes and media practices have been developed for input and output use with a great variety of processing equipment.

The coded character set of table 3 has not been extensively used for input or output in automatic information processing for a number of reasons. One reason is the requirement for a case shift to represent the characters in the set; another reason is the lack of order in code assignments from the standpoint of information processing by machine methods.

Recognizing that a standard coded character set was required to transmit data between the various automatic information processing centers and their associated equipment, the Department of the Army developed an eight unit code (FIELDATA) which was approved as a Military Standard in 1960 (see table 4). This code has been used in a number of communications and automatic data systems developed by the Department of Defense as well as in some commercial automatic data processing equipment. The great majority of data processing equipment has; however, used codes; media and recording format chosen by each manufacturer. The problem of information interchange between these equipment has grown more acute as their use has increased, not only in the Government, but in commercial applications as well.

During recent years, through the cooperative effort of representatives of the data processing industry, the communications industry, and the Federal Government, a coded character set has been developed and approved as a USA Standard Code for Information Interchange (USASCII) X3.4-1967, revision of X3.4-1965. This coded character set, in addition to having many of the features of the FIELDATA code, possesses a character order more acceptable for data manipulation and processing purposes. The USASCII is intended to serve as a universal code for input/output purposes and for information interchange in automatic data processing, data transmission and data capture where coded characters are used. The general use of a standard coded character set will minimize requirements for code conversion and related types of intermediate processing operations when exchanging information in machine code form throughout the Department of Defense.

During the past six years, intensive effort has been applied to obtain international agreement on a code for information interchange. The coded character set shown in Table 1 reflects a considerable amount of international consideration before May 1966. At this time the International Standards Organization (ISO) and the International Consultation Committee Telegraph and Telephone (CCITT) of the International Telecommunications Union (ITU), as specialized agency of the United Nations, and the USA Standards Institute (USASI) proposed certain minor changes now incorporated in Table 1. These changes were not reflected in Change Notice No. 1 to MIL-STD-188B because they had not been officially approved by the USASI. The changes were approved, however, on July 7, 1967. In 1966 the CCITT announced that the international version of the code shall be known as the International Telegraph Alphabet No. 5 (ITA No. 5). The international version has reserved code table positions 4/0, 5/11, 5/12, 5/13, 7/11, 7/12 and 7/13 for national use. The USASI has assigned relatively unimportant characters to these positions so that their use may be dispensed within certain international traffic with a minimum of difficulty.

The USA Standard Code for Information Interchange, commonly referred to as USASCII or ASCII, was made a Federal Standard by a Memorandum of the President of the United States on 11 March 1968. This Appendix is therefore in accordance with the July 7, 1967 revision of USASCII and the Federal Standard established in the Presidential Memorandum.

Certain major procurements were made based upon the pre-May 1966 version of USASCII. These equipments should not be considered nonstandard unless operational incompatibilities result but a planned effort should be made to convert to Table 1 operation at the earliest necessary date, depending upon operational difficulties. The changes made in the USASCII were:

a. In position 1/10 the SS (Special Sequence) was replaced with SUB (Substitute).

b. The "@" was moved from position 6/0 to 4/0 and the "grave accent" from position 4/0 to 6/0.

c. The "Tilde" in position 5/12 was changed to "reverse slant."

d. The "overscore" was moved from position 7/12 to 7/14 and represented by the "Tilde" which it doubles for and the "vertical line" was moved from position 7/14 to 7/12 and represented by a two-segment broken vertical line.

The information contained in this appendix is derived from the USA Standard Code for Information Interchange X3.4-1968 and is included in this standard with the permission of the USA Standards Institute.

That portion of X3.4-1968 that concerns the "New Line" (NL) convention has not been adopted as a Federal Standard whereas the provisions of X3.4-1967 have been pursuant to Federal Information Processing Standards Publications 1 and 7 (FIPS PUBS 1 and 7) published by the US Department of Commerce/National Bureau of Standards.

2. USA STANDARD CODE FOR INFORMATION INTERCHANGE (USASCII).

2.1 The USASCII is to be used for the general interchange of information among information processing systems and communication systems, of a character conscious type, used by the Departments and Agencies of the Department of Defense.

2.2 Table 1 contains Printing Symbols for the 128 characters of USASCII. Where standards for printing symbols for the control characters have not yet been established for USASCII, Table 1 contains recommended symbols for control characters in columns 0 and 1 and for "delete" in position 7/15. Table 1 also has added two noncoded graphics; the diamond (◇) as the symbol to indicate a detected error and the heart (♡) as a general symbol to indicate control characters (see par. 2.5.3).

2.3 Character Representation. The standard 7-bit character representation with b_7 the high-order bit and b_1 the low-order bit, is shown below. (Order of bit transmission is specified in paragraph 2.6.4 of this appendix.)

EXAMPLE: The bit representation for the character "K" (see Table 1) is:

b_7	b_6	b_5	b_4	b_3	b_2	b_1
1	0	0	1	0	1	1

The code table position for the character "K" may also be represented by the notation "column 4, row 11" or alternatively as "4/11." The decimal equivalent of the binary number formed by bits b_7, b_6, and b_5, collectively, forms the column number, and the decimal equivalent of the binary number formed by bits b_4, b_3, b_2 and b_1 collectively, forms the row number.

2.4 LEGEND

2.4.1 Control Characters:

NUL	Null
SOH	Start of Heading (CC)
STX	Start of Text (CC)
ETX	End of Text (CC)
EOT	End of Transmission (CC)
ENQ	Enquiry (CC)
ACK	Acknowledge (CC)
BEL	Bell(Audible or attention signal)
BS	Backspace (FE)
HT	Horizontal Tabulation (punched card skip) (FE)
LF	Line Feed (FE)
VT	Vertical Tabulation (FE)
FF	Form Feed (FE)
CR	Carriage Return (FE)
SO	Shift Out
SI	Shift In
DLE	Data Link Escape (CC)
DC1	Device Control 1
DC2	Device Control 2
DC3	Device Control 3
DC4	Device Control 4 (Stop)
NAK	Negative Acknowledge (CC)
SYN	Synchronous Idle (CC)
ETB	End of Transmission Block (CC)
CAN	Cancel
EM	End of Medium
SUB	Substitute
ESC	Escape
FS	File Separator (IS)
GS	Group Separator (IS)
RS	Record Separator (IS)
US	Unit Separator (IS)
DEL	Delete[1]

NOTE:

(CC)	Communication Control
(FE)	Format Effector
(IS)	Information Separator
(1)	In the strict sense, DEL is not a control character.

2.4.1.1 When a control character is represented by a single graphic symbol, the symbol shall be that which appears to the right of the control abbreviation in table 1.

2.4.2 Graphic Characters:

Column/Row	Symbol	Name
2/0	SP	Space (normally non-printing)
2/1	!	Exclamation Point
2/2	"	Quotation Marks (Diaeresis[1])
2/3	#	Number Sign[2]
2/4	$	Dollar Sign
2/5	%	Percent
2/6	&	Ampersand
2/7	'	Apostrophe (Closing Single Quotation Mark; Acute Accent[1])
2/8	(	Opening Parenthesis
2/9	)	Closing Parenthesis
2/10	*	Asterisk
2/11	+	Plus
2/12	,	Comma (Cedilla[1])
2/13	-	Hyphen (Minus)
2/14	.	Period (Decimal Point)
2/15	/	Slant
3/10	:	Colon
3/11	;	Semicolon
3/12	<	Less Than
3/13	=	Equals
3/14	>	Greater Than
3/15	?	Question Mark[2]
4/0	@	Commercial At[2]
5/11	[	Opening Bracket[2]
5/12	\	Reverse Slant[2]
5/13	]	Closing Bracket[2]
5/14	^	Circumflex[1,2]
5/15	_	Underline
6/0	`	Grave Accent[1,2] (opening single quotation mark)
7/11	{	Opening Brace[2]
7/12	¦	Vertical Line
7/13	}	Closing Brace[2]
7/14	~	Overline[2] (Tilde; General Accent[1])
Not Coded	◊	Diamond
Not Coded	♡	Heart

---

[1] The symbols in 2/2, 2/7, 2/12, 5/14, 6/0 and 7/14 may be used as diacritical marks by preceding them with an alphabetic character and BS (Backspace) in that sequence.

[2] These characters should not be used in international interchange without determining that there is agreement between sender and recipient.

2.5 DEFINITIONS

2.5.1 General:

(CC) Communication Control: A functional character intended to control or facilitate transmission of information over communication networks.

(FE) Format Effector: A functional character which controls the layout or positioning of information in printing or display devices.

(IS) Information Separator: A character which is used to separate and qualify information in a logical sense. There is a group of four such characters, which are to be used in a hierarchical order.

2.5.2 Control Characters:

NUL: The all zeros character.

SOH (Start of Heading): A communication control character used at the beginning of a sequence of characters which constitute a machine-sensible address or routing information. Such a sequence is referred to as the "heading". An STX character has the effect of terminating a heading.

STX (Start of Text): A communication control character which precedes a sequence of characters that is to be treated as an entity and entirely transmitted through to the ultimate destination. Such a sequence is referred to as "text". STX may be used to terminate a sequence of characters started by SOH.

ETX (End of Text): A communication control character used to terminate a sequence of characters started with STX and transmitted as an entity.

EOT (End of Transmission): A communication control character, used to indicate the conclusion of a transmission, which may have contained one or more texts and any associated headings.

ENQ (Enquiry): A communication control character used in data communication systems as a request for a response from a remote station. It may be used as a "Who Are You"(WRU) to obtain identification, or may be used to obtain station status, or both.

ACK (Acknowledge): A communication control character transmitted by a receiver as an affirmative response to a sender.

BEL: A character for use when there is a need to call for human attention. It may control alarm or attention devices.

BS (Backspace): A format effector which controls the movement of the printing position one printing space backward on the same printing line. (Applicable to display devices).

HT (Horizontal Tabulation): A format effector which controls the movement of the printing position to the next in a series of predetermined positions along the printing line. (Applicable also to display devices and the skip function on punched cards.)

LF (Line Feed): A format effector which controls the movement of the printing position to the next printing line. (Applicable also to display devices.) Where appropriate, this character may have the meaning "New Line" (NL), a format effector which controls the movement of the printing point to the first printing position on the next printing line. Use of this convention requires agreement between sender and recipient of data. (So long as the current operating procedure of ending (or beginning) a line with CR-CR-LF is observed no operational problem arises from interconnecting "NL" and "Non-NL" machines.)

VT (Vertical Tabulation): A format effector which controls the movement of the printing position to the next in a series of predetermined printing lines. (Applicable also to display devices.)

FF (Form Feed): A format effector which controls the movement of the printing position to the first predetermined printing line on the next form or page. (Applicable also to display devices.)

CR (Carriage Return): A format effector which controls the movement of the printing position to the first printing position on the same printing line. (Applicable also to display devices.)

SO (Shift Out): A control character indicating that the code combinations which follow shall be interpreted as outside of the character set of the standard code table until a Shift In character(s) is (are) reached.

SI (Shift In): A control character indicating that the code combinations which follow shall be interpreted according to the standard code table.

DLE (Data Link Escape): A communication control character which will change the meaning of a limited number of contiguously following characters. It is used exclusively to provide supplementary controls in data communication networks. DLE is usually terminated by a Shift In character(s).

DC1, DC2, DC3, DC4 (Device Controls): Characters for the control of ancillary devices associated with data processing or telecommunication systems, more especially switching devices "on" or "off". (If a single "stop" control is required to interrupt or turn off ancillary devices, DC4 is the preferred assignment.)

NAK (Negative Acknowledge): A communication control character transmitted by a receiver as a negative response to the sender.

SYN (Synchronous Idle): A communication control character used by a

synchronous transmission system in the absence of any other character to provide a signal from which synchronism may be achieved or retained.

ETB (End of Transmission Block): A communication control character used to indicate the end of a block of data for communication purposes. ETB is used for blocking data where the block structure is not necessarily related to the processing format.

CAN (Cancel): A control character used to indicate that the data with which it is sent is in error or is to be disregarded.

EM (End of Medium): A control character associated with the sent data which may be used to identify the physical end of the medium, or the end of the used, or wanted, portion of information recorded on a medium. (The position of the character does not necessarily correspond to the physical end of the medium.)

SUB (Substitute): A character that may be substituted for a character which is determined to be invalid or in error.

ESC (Escape): A control character intended to provide code extension (supplementary characters) in general information interchange. The Escape character itself is a prefix affecting the interpretation of a limited number of contiguously following characters. ESC is usually terminated by a Shift In character(s).

FS (File Separator), GS (Group Separator), RS (Record Separator) and US (Unit Separator). These information separators may be used within data in optional fashion, except that their hierarchical relationship shall be: FS is the most inclusive, then GS, then RS, and US is least inclusive. (The content and length of a File, Group, Record, or Unit are not specified).

DEL (Delete): This character is used primarily to "erase" or "obliterate" erroneous or unwanted characters in perforated tape. (In the strict sense DEL is not a control character).

Note: SO, ESC, and DLE are all characters which can be used, at the discretion of the designer, to indicate the beginning of a sequence of digits having special significance.

2.5.3 Graphic Characters:

SP (Space): A normally nonprinting graphic character used to separate words. It is also a format effector which controls the movement of the printing position, one printing position forward. (Applicable also to display devices.)

(Diamond): A noncoded graphic which shall be printed by a printing device to denote the sensing of an error when such an indication is required. As an interim standard, an asterisk (*) may be used for this function.

(Heart): A noncoded graphic which may be printed by a printing device in lieu of the symbols for the control characters shown in columns 0 and 1 in table 1 of this appendix.

2.6 General Considerations

2.6.1 The relative sequence of any two characters of the code table, when used as a basis for collation, is defined by their binary values.

2.6.2 No specific meaning is prescribed for any of the graphics in the code table except that which is understood by the users. Furthermore, this standard does not specify a type style for the printing or display of the various graphic characters.

2.6.3 For military purposes, a parity bit, b_8 is always added to the standard character. Requirements for parity are described in paragraph 6.1.1.3 of the basic Standard.

2.6.4 In serial by bit transmission, the coded character will be transmitted low order first; i.e., the bits will appear on-line in the order b_1, b_2, b_3, b_4, b_5, b_6, b_7, b_8 (parity).

2.6.5 Special Consideration. An option is available in the use of ASCII to use line feed as new line (see the definition of line feed above). In the Military Systems, the current practice of transmitting two carriage returns and one line feed will be continued. However, it shall be standard to procure new line equipment when available at no increase (or an insignificant increase) in cost and use it in accordance with the old practice. This has the advantage of becoming prepared, at no additional cost, to cutting over to new line operation should this ever be desirable while maintaining compatibility between old and new equipments in the interim.

2.7 Printing Symbols

2.7.1 128-Symbol Set. The complete standard set of 128 printing symbols is given in table 1. There are actually only 127 printing symbols since the space is non-printing.

2.7.2 96-Symbol Set. The standard 96 symbol subset of printing symbols comprises the symbols contained in columns 2 through 7 of table 1. (95 printing symbols plus space). The heart symbol may be printed in lieu of the symbol for the control characters shown in columns 0 and 1 in table 1 of this appendix.

2.7.3 64-Symbol Set. The standard 64-symbol subset of printing symbols for page printer applications is given in table 2. The heart symbol may be printed in lieu of the symbol for the control characters shown in columns 0 and 1 in table 1 of this appendix.

3. FOUR-ROW KEYBOARDS. Four-row keyboards are standard for the implementation of ASCII and for OCR message preparation units. The

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AMERICAN STANDARD CODE FOR INFORMATION INTERCHANGE

	128-SYMBOL PRINTING SET								
COLUMN →	0	1	2	3	4	5	6	7	
b7 b6 b5	0 0 0	0 0 1	0 1 0	0 1 1	1 0 0	1 0 1	1 1 0	1 1 1	ROW ↓
b4 b3 b2 b1	← NON-PRINTING (4) →		← 96-SYMBOL PRINTING SUBSET →						
0 0 0 0	NUL \	DLE ⊖	SP	0	@	P		p	0
0 0 0 1	SOH Γ	DC1 ◷	!	1	A	Q	a	q	1
0 0 1 0	STX ⊥	DC2 ◶	"	2	B	R	b	r	2
0 0 1 1	ETX ┘	DC3 ◵	#	3	C	S	c	s	3
0 1 0 0	EOT ⊣	DC4 ◴	$	4	D	T	d	t	4
0 1 0 1	ENQ ✢	NAK ⊗	%	5	E	U	e	u	5
0 1 1 0	ACK ⋈	SYN ⦶	8	6	F	V	f	v	6
0 1 1 1	BEL 🔔	ETB ⊕	' (APOS)	7	G	W	g	w	7
1 0 0 0	BS ◁	CAN ⊠	(	8	H	X	h	x	8
1 0 0 1	HT ▷	EM ⊞	)	9	I	Y	i	y	9
1 0 1 0	LF ≡	SUB ◫	*	:	J	Z	j	z	10
1 0 1 1	VT ∇	ESC ⊟	+	;	K	[	k	{	11
1 1 0 0	FF ∇̲	FS ▣	,	<	L	\	l	¦	12
1 1 0 1	CR «	GS ▣	-	=	M	]	m	}	13
1 1 1 0	SO Λ	RS ▣	.	>	N	^	n	~	14
1 1 1 1	SI ∨	US ▣	/	?	O	_	o	DEL ▭	15

NOTES:
(1) Columns 0 & 1 show the mnemonic abbreviations and the printing symbols for the control characters.
(2) The diamond (◇) is printed to indicate the detection of an error.
(3) The heart (♡) may be printed to indicate a character of the control character sub-set.
(4) Non-printing codes in the 96-symbol Printing Set.

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1 Dec 1964
Rev. 07-13-67
Rev. 10-14-69

Table 1. American Standard Code for Information Interchange

SCL-4713

AMERICAN STANDARD CODE FOR INFORMATION INTERCHANGE

64-SYMBOL PAGE PRINTING SUBSET

COLUMN →	0	1	2	3	4	5	6	7	
b7 b6 b5	0 0 0	0 0 1	0 1 0	0 1 1	1 0 0	1 0 1	1 1 0	1 1 1	ROW ↓
b4 b3 b2 b1	← NON-PRINTING →		← PRINTING →						
0 0 0 0	NUL \	DLE ⊖	SP	0	@	P	@	P	0
0 0 0 1	SOH Γ	DC1 ◷	!	1	A	Q	A	Q	1
0 0 1 0	STX ⊥	DC2 ◶	"	2	B	R	B	R	2
0 0 1 1	ETX ⌋	DC3 ◵	#	3	C	S	C	S	3
0 1 0 0	EOT ⊣	DC4 ◴	$	4	D	T	D	T	4
0 1 0 1	ENQ ✠	NAK ⊗	%	5	E	U	E	U	5
0 1 1 0	ACK ⊶	SYN ⦶	&	6	F	V	F	V	6
0 1 1 1	BEL 🔔	ETB ⊕	' (APOS)	7	G	W	G	W	7
1 0 0 0	BS ◁	CAN ⊠	(	8	H	X	H	X	8
1 0 0 1	HT ▷	EM ⊞	)	9	I	Y	I	Y	9
1 0 1 0	LF ≡	SUB ◫	*	:	J	Z	J	Z	10
1 0 1 1	VT ∇	ESC ⊟	+	;	K	[	K	[	11
1 1 0 0	FF ∇̲	FS ◰	,	<	L	\	L	\	12
1 1 0 1	CR «	GS ◳	-	=	M	]	M	]	13
1 1 1 0	SO ⋀	RS ◲	.	>	N	^	N	^	14
1 1 1 1	SI ⋁	US ◱	/	?	O	_	O	DEL _	15

The diamond (◊) is printed to indicate the detection of an error.
The heart (♡) may be printed to indicate a character of the control character sub-set.

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Rev. 10-14-69

Table 2. 64-Symbol Subset (Page Printer Application)

CHARACTERS LOWER CASE	UPPER CASE COMM	UPPER CASE WEATHER	CODE SIGNALS START	1	2	3	4	5	STOP	CCITT NO.2 UPPER CASE ✻
A	—	↑		▨	▨				▨	
B	?	⊕		▨			▨	▨	▨	
C	:	○			▨	▨	▨		▨	
D	$	↗		▨			▨		▨	WRU
E	3	3		▨					▨	
F	!	→		▨		▨	▨		▨	UNASSIGNED
G	&	↘			▨		▨	▨	▨	UNASSIGNED
H	STOP	↓				▨		▨	▨	UNASSIGNED
I	8	8			▨	▨			▨	
J	'	↙		▨	▨		▨		▨	AUDIBLE SIGNAL
K	(	←		▨	▨	▨	▨		▨	
L	)	↖			▨			▨	▨	
M	.	.				▨	▨	▨	▨	
N	,	⦷				▨	▨		▨	
O	9	9					▨	▨	▨	
P	0	0			▨	▨		▨	▨	
Q	1	1		▨	▨	▨		▨	▨	
R	4	4			▨		▨		▨	
S	BELL	BELL		▨		▨			▨	'(APOSTROPHE)
T	5	5						▨	▨	
U	7	7		▨	▨	▨			▨	
V	;	⦶			▨	▨	▨	▨	▨	=
W	2	2		▨	▨			▨	▨	
X	/	/		▨		▨	▨	▨	▨	
Y	6	6		▨		▨		▨	▨	
Z	"	+		▨				▨	▨	+
BLANK		—							▨	
SPACE						▨			▨	
CAR. RET.							▨		▨	
LINE FEED					▨				▨	
FIGURES				▨	▨		▨	▨	▨	
LETTERS				▨	▨	▨	▨	▨	▨	

NOTE: UPPER CASE H (COMM) MAY BE STOP OR #

▨ MARKING PULSE

☐ SPACING PULSE

✻ THIS COLUMN SHOWS ONLY THOSE CHARACTERS WHICH DIFFER FROM THE U.S.A. VARIATION

Table 3 International Telegraph Alphabet No. 2, American Variation

I_1 -I_2-C →				000		100		010		110		001		101		011		111	
D_0 ↓	D_1 ↓	D_2 ↓	D_3 ↓		P ↓		P ↓		P ↓		P ↓		P ↓		P ↓		P ↓		P ↓
0	0	0	0		1		0		0		1	Mast. Sp.	0	K	1	)	1	0	0
1	0	0	0		0		1		1		0	Up. Case	1	L	0	-	0	1	1
0	1	0	0		0		1		1		0	Lwr. Case	1	M	0	+	0	2	1
1	1	0	0		1		0		0		1	Line Feed	0	N	1	<	1	3	0
0	0	1	0		0		1		1		0	Car. Ret.	1	O	0	=	0	4	1
1	0	1	0		1		0		0		1	Space	0	P	1	>	1	5	0
0	1	1	0		1		0		0		1	A	0	Q	1	(underline) _	1	6	0
1	1	1	0		0		1		1		0	B	1	R	0	$	0	7	1
0	0	0	1		0		1		1		0	C	1	S	0	*	0	8	1
1	0	0	1		1		0		0		1	D	0	T	1	(	1	9	0
0	1	0	1		1		0		0		1	E	0	U	1	"	1	'	0
1	1	0	1		0		1		1		0	F	1	V	0	:	0	;	1
0	0	1	1		1		0		0		1	G	0	W	1	?	1	/	0
1	0	1	1		0		1		1		0	H	1	X	0	!	0	.	1
0	1	1	1		0		1		1		0	I	1	Y	0	,	0	Spec. □	1
1	1	1	1		1		0		0		1	J	0	Z	1	+ (Stop)	1	Idle	0
				← CONTROL FUNCTIONS (Under Study) →								← ALPHANUMERICS →							

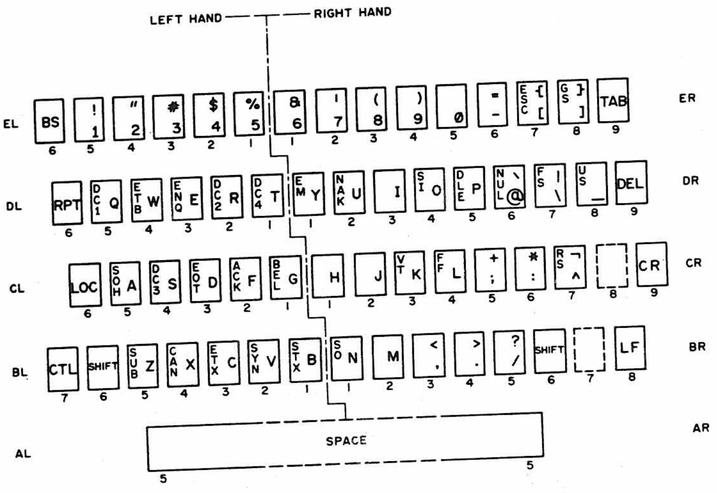
Sequence of Signal Elements for Serial Transmission: D_0 - D_1 - D_2 - D_3 - I_1 - I_2 - C - P

Example: Letter "C": 0 0 0 1 0 0 1 1

P is standard transmission parity bit added to give odd parity for error control.

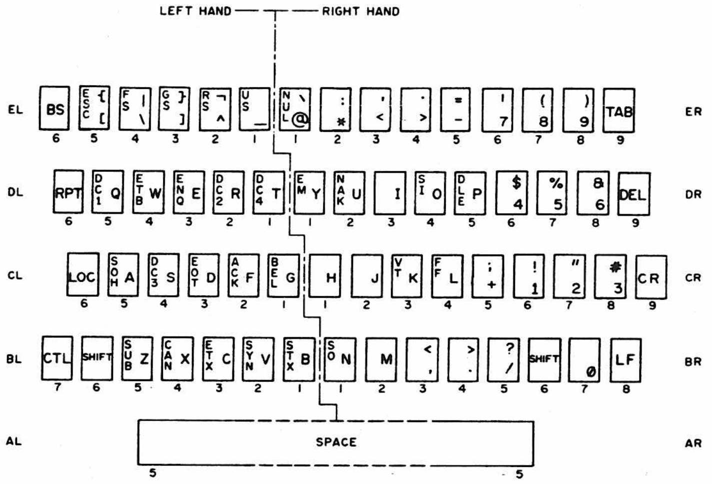
For punched tape, all parity bits are automatically reversed to give even parity.

TABLE 4. Interim standard coded character set for information interchange (Fieldata)



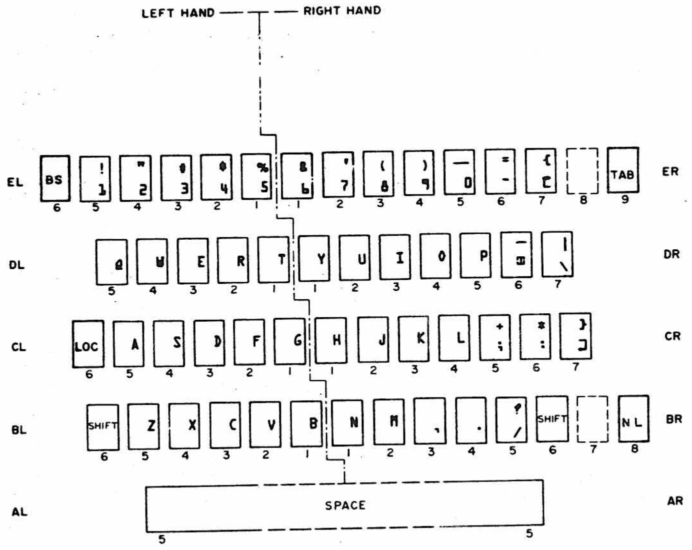
NOTES
1 PHYSICAL CHARACTERISTICS AND LOCATIONS (i.e. SIZE, SHAPE, SKEW, ETC) OF SPACE BAR OR KEYS ARE NOT TO BE INFERRED
2 ARRANGEMENT TYPE I, CLASS I AS PER MIL-STD-1280

FIGURE 1 TYPE I, CLASS I STANDARD KEYBOARD ARRANGEMENT



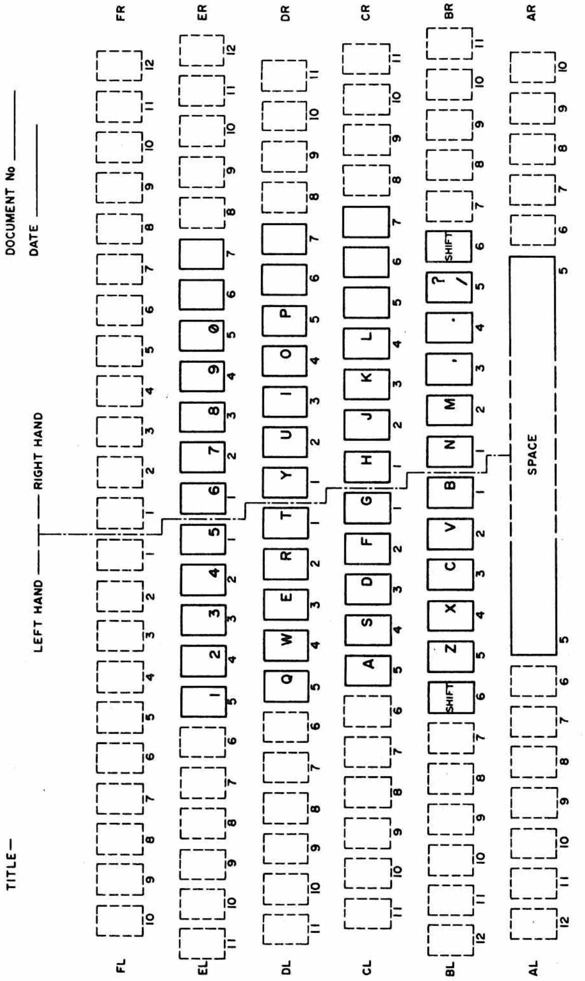
NOTES
1 PHYSICAL CHARACTERISTICS AND LOCATIONS (i.e. SIZE, SHAPE, SKEW, ETC) OF SPACE BAR OR KEYS ARE NOT TO BE INFERRED
2 ARRANGEMENT TYPE I, CLASS 2 AS PER MIL-STD-1280

FIGURE 2 TYPE I, CLASS 2 STANDARD KEYBOARD ARRANGEMENT



NOTES
1 PHYSICAL CHARACTERISTICS AND LOCATIONS (i.e. SIZE, SHAPE, SKEW, ETC) OF SPACE BAR OR KEYS ARE NOT TO BE INFERRED
2 SOLID KEY OUTLINES CORRESPOND TO USAS X4.7-1966
3 THE UPPER CHARACTER ON KEY ER5 WILL BE THE "GROUP ERASE" WHICH WILL APPEAR IN A REVISION OF USAS X3.17-1966

FIGURE 3 TYPE II, CLASS I STANDARD KEYBOARD ARRANGEMENT

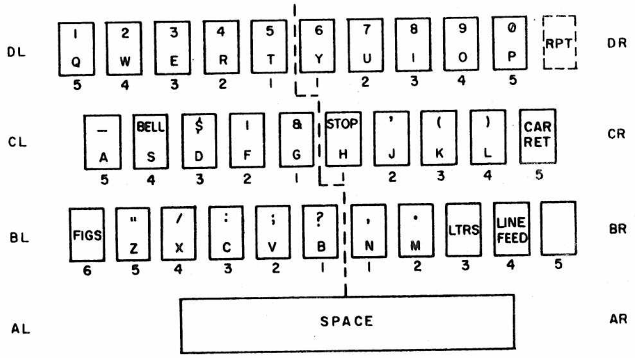


NOTES

1 PHYSICAL CHARACTERISTICS AND LOCATIONS (i.e. SIZE, SHAPE, SKEW, ETC) OF SPACE BAR OR KEYS ARE NOT TO BE INFERRED

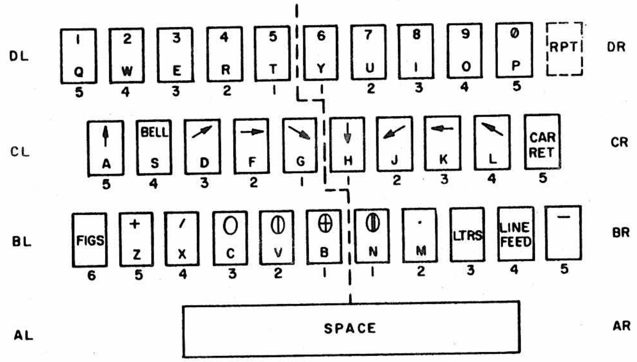
2 SOLID KEY OUTLINES CORRESPOND TO USAS X4.7-1966

FIGURE 4 KEYBOARD ARRANGEMENT NOTATIONAL SYSTEM


DL
CL
BL
AL
DR
CR
BR
AR
1 Q 2 W 3 E 4 R 5 T 6 Y 7 U 8 I 9 O 0 P RPT
— A BELL S $ D ! F & G STOP H ' J (K) L CAR RET
FIGS " Z / X : C ; V ? B , N . M LTRS LINE FEED
SPACE

NOTE: UPPER CASE H MAY BE STOP OR #

THREE ROW COMMUNICATION KEYBOARD (INTERIM STANDARD)


DL
CL
BL
AL
DR
CR
BR
AR
1 Q 2 W 3 E 4 R 5 T 6 Y 7 U 8 I 9 O 0 P RPT
A BELL S D F G H J K L CAR RET
FIGS + Z / X C V B N . M LTRS LINE FEED
SPACE

THREE ROW WEATHER KEYBOARD (INTERIM STANDARD)

FIGURE 5. THREE ROW KEYBOARDS

standards arrangements are included as Figures 1, 2 and 3. For details on the application of these arrangements, the designer is advised to consult MIL-STD-1280, Keyboard Arrangements. Figure 4 is the standard notation system for keyboard arrangements.

4. THREE-ROW KEYBOARDS. Refer to Figure 5 for three-row communication and weather keyboards.

5. INTERNATIONAL TELEGRAPH ALPHABET NO. 2, USA VARIATION. See Table 3. This is now classified as interim standard.

6. INTERIM STANDARD CODED CHARACTER SET FOR INFORMATION INTERCHANGE (FIELDATA). See Table 4.

7. CODE CORRESPONDENCE. This is a reference paragraph only. It does not in itself establish any code as a standard. It merely establishes the relationship between some commonly used codes so that translations may be made. Although the USASCII is standard the USA Standard Punched Card Code and the EBCDIC is also used. The first eight columns of Table 5 presents the 128 hole-patterns for the 128 characters of USASCII. The last eight columns present the extension of the code to 256 characters. This extension has been approved by USASI and will be published as USASI Standard X3.26-1969. For the present, only the hole-patterns have been assigned to the bit-patterns in the extension. Table 6 is a cross reference from the Hollerith hole-patterns to the USASCII graphic and control characters.

As of March 1968, the AUTODIN Digital Subscriber Terminal Equipment has the capability of operating with 64 hole-patterns. However, only 50 hole-patterns are currently active. Plans for activating the remaining 14 hole-patterns and for aligning the equipment with the Standard Hollerith Punched Card Code are not firm at this time. The correspondence between AUTODIN punched card practice and the Standard Hollerith Punched Card Code for all USASCII graphic characters is presented in Table 7.

The interim standard punched card practice for the Worldwide Military Command and Control System was published in Chapter II, Section 2 of JCS Pub 7 of 3 February 1964. Its correspondence with the Standard Hollerith Punched Card Code and with AUTODIN is also given in Table 7. Note that this interim standard uses characters which are not in USASCII.

The EBCDIC is presented in Table 8. Note that here too in 128 instances, only the hole-patterns have been assigned to the bit-patterns. The other 128 are the assigned positions of the USASCII characters.

---

b8 b7b6b5		0 000	0 001	0 010	0 011	0 100	0 101	0 110	0 111	1 000	1 001	1 010	1 011	1 100	1 101	1 110	1 111	
bbbb 4321	COL ROW	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	COL ROW
0000	0	NUL 12-0-9-8-1	DLE 12-11-9-8-1	SP NO PCH	0 0	@ 8-4	P 11-7	8-1	p 12-11-7	11-0-9-8-1	12-11-0-9-8-1	12-0-9-1	12-11-9-8	12-11-0-9-6	12-11-8-7	12-11-0-8	12-11-9-8-4	0
0001	1	SOH 12-9-1	DC1 11-9-1	! 12-8-7	1 1	A 12-1	Q 11-8	a 12-0-1	q 12-11-8	0-9-1	9-1	12-0-9-2	11-8-1	12-11-0-9-7	11-0-8-1	12-11-0-9	12-11-9-8-5	1
0010	2	STX 12-9-2	DC2 11-9-2	" 8-7	2 2	B 12-2	R 11-9	b 12-0-2	r 12-11-9	0-9-2	11-9-8-2	12-0-9-3	11-0-9-2	12-11-0-9-8	11-0-8-2	12-11-0-8-2	12-11-9-8-6	2
0011	3	ETX 12-9-3	DC3 11-9-3	# 8-3	3 3	C 12-3	S 0-2	c 12-0-3	s 11-0-2	0-9-3	9-3	12-0-9-4	11-0-9-3	12-0-8-1	11-0-8-3	12-11-0-8-3	12-11-9-8-7	3
0100	4	EOT 9-7	DC4 9-8-4	$ 11-8-3	4 4	D 12-4	T 0-3	d 12-0-4	t 11-0-3	0-9-4	9-4	12-0-9-5	11-0-9-4	12-0-8-2	11-0-8-4	12-11-0-8-4	11-0-9-8-2	4
0101	5	ENQ 0-9-8-5	NAK 9-8-5	% 0-8-4	5 5	E 12-5	U 0-4	e 12-0-5	u 11-0-4	11-9-5	9-5	12-0-9-6	11-0-9-5	12-0-8-3	11-0-8-5	12-11-0-8-5	11-0-9-8-3	5
0110	6	ACK 0-9-8-6	SYN 9-2	& 12	6 6	F 12-6	V 0-5	f 12-0-6	v 11-0-5	12-9-6	9-6	12-0-9-7	11-0-9-6	12-0-8-4	11-0-8-6	12-11-0-8-6	11-0-9-8-4	6
0111	7	BEL 0-9-8-7	ETB 0-9-6	' 8-5	7 7	G 12-7	W 0-6	g 12-0-7	w 11-0-6	11-9-7	12-9-8	12-0-9-8	11-0-9-7	12-0-8-5	11-0-8-7	12-11-0-8-7	11-0-9-8-5	7
1000	8	BS 11-9-6	CAN 11-9-8	(12-8-5	8 8	H 12-8	X 0-7	h 12-0-8	x 11-0-7	0-9-8	9-8	12-8-1	11-0-9-8	12-0-8-6	12-11-0-8-1	12-0-9-8-2	11-0-9-8-6	8
1001	9	HT 12-9-5	EM 11-9-8-1	) 11-8-5	9 9	I 12-9	Y 0-8	i 12-0-9	y 11-0-8	0-9-8-1	9-8-1	12-11-9-1	0-8-1	12-0-8-7	12-11-0-1	12-0-9-8-3	11-0-9-8-7	9
1010	10	LF 0-9-5	SUB 9-8-7	* 11-8-4	: 8-2	J 11-1	Z 0-9	j 12-11-1	z 11-0-9	0-9-8-2	9-8-2	12-11-9-2	12-11-0	12-11-8-1	12-11-0-2	12-0-9-8-4	12-11-0-9-8-2	10
1011	11	VT 12-9-8-3	ESC 0-9-7	+ 12-8-6	; 11-8-6	K 11-2	[12-8-2	k 12-11-2	{ 12-0	0-9-8-3	9-8-3	12-11-9-3	12-11-0-9-1	12-11-8-2	12-11-0-3	12-0-9-8-5	12-11-0-9-8-3	11
1100	12	FF 12-9-8-4	FS 11-9-8-4	, 0-8-3	< 12-8-4	L 11-3	\ 0-8-2	l 12-11-3	| 12-11	0-9-8-4	12-9-4	12-11-9-4	12-11-0-9-2	12-11-8-3	12-11-0-4	12-0-9-8-6	12-11-0-9-8-4	12
1101	13	CR 12-9-8-5	GS 11-9-8-5	- 11	= 8-6	M 11-4	] 11-8-2	m 12-11-4	} 11-0	12-9-8-1	11-9-4	12-11-9-5	12-11-0-9-3	12-11-8-4	12-11-0-5	12-0-9-8-7	12-11-0-9-8-5	13
1110	14	SO 12-9-8-6	RS 11-9-8-6	. 12-8-3	> 0-8-6	N 11-5	^ 11-8-7	n 12-11-5	¬ 11-0-1	12-9-8-2	9-8-6	12-11-9-6	12-11-0-9-4	12-11-8-5	12-11-0-6	12-11-9-8-2	12-11-0-9-8-6	14
1111	15	SI 12-9-8-7	US 11-9-8-7	/ 0-1	? 0-8-7	O 11-6	_ 0-8-5	o 12-11-6	DEL 12-9-7	11-9-8-3	11-0-9-1	12-11-9-7	12-11-0-9-5	12-11-8-6	12-11-0-7	12-11-9-8-3	EC 12-11-0-9-8-7	15

Table 5. Standard Hollerith Punched Card Code

	12				12	12		12	12				12	12		12	
		11				11	11	11		11				11	11	11	
			0		0		0	0			0		0		0	0	
	&	-	0	SP	{	|	}	11/10	10/8	11/1	11/9	`	12/3	12/10	13/1	13/8	8-1
1	A	J	/	1	a	j	¬	13/9	SOH	DC1	8/1	9/1	10/0	10/9	9/15	11/11	9-1
2	B	K	S	2	b	k	s	13/10	STX	DC2	8/2	SYN	10/1	10/10	11/2	11/12	9-2
3	C	L	T	3	c	l	t	13/11	ETX	DC3	8/3	9/3	10/2	10/11	11/3	11/13	9-3
4	D	M	U	4	d	m	u	13/12	9/12	9/13	8/4	9/4	10/3	10/12	11/4	11/14	9-4
5	E	N	V	5	e	n	v	13/13	HT	8/5	LF	9/5	10/4	10/13	11/5	11/15	9-5
6	F	O	W	6	f	o	w	13/14	8/6	BS	ETB	9/6	10/5	10/14	11/6	12/0	9-6
7	G	P	X	7	g	p	x	13/15	DEL	8/7	ESC	EOT	10/6	10/15	11/7	12/1	9-7
8	H	Q	Y	8	h	q	y	14/0	9/7	CAN	8/8	9/8	10/7	11/0	11/8	12/2	9-8
9	I	R	Z	9	i	r	z	14/1	8/13	EM	8/9	9/9	NUL	DLE	8/0	9/0	9-8-1
8-2	[	]	\	:	12/4	12/11	13/2	14/2	8/14	9/2	8/10	9/10	14/8	14/14	15/4	15/10	9-8-2
8-3	.	$	,	#	12/5	12/12	13/3	14/3	VT	8/15	8/11	9/11	14/9	14/15	15/5	15/11	9-8-3
8-4	<	*	%	@	12/6	12/13	13/4	14/4	FF	FS	8/12	DC4	14/10	15/0	15/6	15/12	9-8-4
8-5	(	)	_	'	12/7	12/14	13/5	14/5	CR	GS	ENQ	NAK	14/11	15/1	15/7	15/13	9-8-5
8-6	+	;	>	=	12/8	12/15	13/6	14/6	SO	RS	ACK	9/14	14/12	15/2	15/8	15/14	9-8-6
8-7	!	^	?	"	12/9	13/0	13/7	14/7	SI	US	BEL	SUB	14/13	15/3	15/9	15/15	9-8-7

Table 6. Hollerith Hole-pattern Cross-reference To ASCII

	12	11	0		12 0	12 11	11 0	12 9
	& - +	- / -	0 0 0	SP SP Blk	{ ~ ?	| na na	} ^ !	
1	A A A	J J J	/ & /	1 1 1	a na na	j na na	¬ na na	
2	B B B	K K K	S S S	2 2 2	b na na	k na na	s na na	
3	C C C	L L L	T T T	3 3 3	c na na	l na na	t na na	
4	D D D	M M M	U U U	4 4 4	d na na	m na na	u na na	
5	E E E	N N N	V V V	5 5 5	e na na	n na na	v na na	
6	F F F	O O O	W W W	6 6 6	f na na	o na na	w na na	
7	G G G	P P P	X X X	7 7 7	g na na	p na na	x na na	DEL na na
8	H H H	Q Q Q	Y Y Y	8 8 8	h na na	q na na	y na na	
9	I I I	R R R	Z Z Z	9 9 9	i na na	r na na	z na na	

	12	11	0	
8-1				` na na
8-2	[na na	] na na	\ _ ‡	: ' b
8-3	. . .	$ [$	, , ,	# # =
8-4	< <)	* * *	% % (	@ > '
8-5	(+ [	)]]	_ ? ~	' : :
8-6	+ (<	; ; ;	> $ \	=) >
8-7	! = ‡	^ ! ^	? ` ⧻	" " ✓

← Standard Hollerith
← AUTODIN
← JCS Pub 7
na means not assigned

Table 7. Correspondence of Standard Hollerith, AUTODIN and JCS Pub 7 Punched Card Codes.

			00				01				10				11				Bits x0,x1
			00	01	10	11	00	01	10	11	00	01	10	11	00	01	10	11	Bits x2,x3
			0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	Hex. Col.
Bits xxxx 4567	Hexadecimal Row	Digit Punches	12 9	11 9	0 9	9	12 0 9	12 11 9	11 0 9	12 11 0 9	12 0	12 11	11 0	12 11 0	12	11	0		Zone Punches Digit Punches
0000	0	8-1	•1 NUL	•2 DLE	•3	•4	•5 SP	•6 &	•7 -	•8					•9 {	•10 }	•11 \	•12 0	8-1
0001	1	1	SOH	DC1					•13 /		a	j	¬		A	J	•14	1	1
0010	2	2	STX	DC2		SYN					b	k	s		B	K	S	2	2
0011	3	3	ETX	DC3							c	l	t		C	L	T	3	3
0100	4	4									d	m	u		D	M	U	4	4
0101	5	5	HT		LF						e	n	v		E	N	V	5	5
0110	6	6		BS	ETB						f	o	w		F	O	W	6	6
0111	7	7	DEL		ESC	EOT					g	p	x		G	P	X	7	7
1000	8	8		CAN							h	q	y		H	Q	Y	8	8
1001	9	8-1		EM						`	i	r	z		I	R	Z	9	9
1010	A	8-2					[	]	•15 |	:									8-2
1011	B	8-3	VT				.	$	,	#									8-3
1100	C	8-4	FF	FS		DC4	<	*	%	@									8-4
1101	D	8-5	CR	GS	ENQ	NAK	(	)	_	'									8-5
1110	E	8-6	SO	RS	ACK		+	;	>	=									8-6
1111	F	8-7	SI	US	BEL	SUB	!	^	?	"									8-7
			12 9	11 9	0 9	9	12	11	0		12 0	12 11	11 0	12 11 0	12 0 9	12 11 9	11 0 9	12 11 0 9	Zone Punches

Card Hole Patterns
•1, 12-0-9-8-1
•2, 12-11-9-8-1
•3, 11-0-9-8-1
•4, 12-11-0-9-8-1
•5, No Punches
•6, 12
•7, 11
•8, 12-11-0
•9, 12-0
•10, 11-0
•11, 0-8-2
•12, 0
•13, 0-1
•14, 11-0-9-1
•15, 12-11

Table 8. EBCDIC Card Code

APPENDIX D

STANDARD SWITCHING INSTRUCTIONS AND BIT STRUCTURES FOR START/STOP AND SYNCHRONOUS AUTOMATIC TELEPRINTER SWITCHING EQUIPMENT UTILIZING ITA No. 2

This appendix sets forth guidance with regard to switching instructions and bit patterns as they apply (1963) for teletypewriter switching equipment. In case of conflict between any specific instructions in this appendix and any applicable portion of ACP-127 ( ), the requirements of ACP-127 ( ) shall govern.

NOTE: JANAP 128 ( ) AUTOMATIC DIGITAL NETWORK (AUTODIN) OPERATING PROCEDURES has been published by the Joint Chiefs of Staff and prescribes the standard data communication policies, practices, procedures, and routing doctrine for operation of the Defense Communication System AUTODIN. The latest issue in effect of JANAP 128 ( ) should be referred to for all AUTODIN Operating Procedures.

1. GENERAL

The switching instructions listed in the standard message format permit a subsystem to forward messages without difficulty and in accordance with present world-wide equipment and agreed practices.

1.1 Start of message instruction, channel designator and serial number: format line # 1.

1.2 Precedence instruction: end of format line # 1, beginning of format line # 2.

1.3 Routing Instruction: format line # 2.

1.4 End of routing instruction: end of format line # 2, beginning of format line # 3.

1.5 Format lines 3 and 4 are not generally utilized by automatic switching equipment at this time except as noted in processing ACP 127 messages into AUTODIN.

1.6 Format lines 5 thru 10 are standardized proceedurally but are not utilized at this time for automatic switching.

1.7 Format line 10 is used to count code groups in the text.

1.8 End of address instruction, start of text instruction: format line 11.